GCMP
GREATER CLEVELAND MATHEMATICS PROGRAM

Teacher's Guide for Kindergarten

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Prepared by the staff of the Educational Research Council of Greater Cleveland, assisted by teachers from the participating Council Schools.

Co-ordinator: Lucille McCraith

S R A

Science Research Associates, Inc.
259 East Erie Street, Chicago 11, Illinois

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Kindergarten Content

I Physical Geometry

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C. Visual patterns

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C. Set union
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INTRODUCTION

WHEN the five-year-old child enters school, he comes equipped with a natural curiosity about the world around him. He eagerly investigates his environment and is able to make simple generalizations about the objects which surround him. He has discovered that language is a useful tool in formulating and communicating his ideas. He notes that many objects have the same color and learns that this particular color is named "blue." He has found that three cookies, three dogs, three children, and three toys have a common property; he describes this property by using the word "three."

Just as the child's curiosity leads him to make generalizations about his physical environment, it also leads him to test and apply these generalizations in many new situations. It is the responsibility of the Kindergarten teacher to keep alive this sense of curiosity, to encourage the child to examine his environment critically in search of new patterns and new ideas, and to help him find relationships among these ideas. The skillful teacher does not give answers when no questions have been asked. Rather she leads the child to ask questions and then helps him use known facts to discover the answers for himself. She supplies new language when it is needed and encourages the child to verbalize his thoughts. In short, she provides an environment conducive to meaningful learning.

It is in the area of arithmetic that the primary teacher has perhaps her greatest chance to help the child begin to develop his powers of reason. Mathematics, man's greatest system of logic, offers untold opportunities for the discovery of relationships and for both inductive and deductive reasoning.

To provide exciting adventures for young minds, the Greater Cleveland Mathematics Program (GCMP) utilizes both the logical structure of mathematics and the discovery approach to learning. The child's natural curiosity is stimulated and guided toward meaningful learning. The importance of patterns and relationships is stressed as the child moves from concrete experiences to abstract ideas and as he applies these ideas in new situations. Basic mathematical concepts are developed, then tested and extended again and again. Continuity and creativity are stressed throughout the program.

The materials of GCMP are designed to provide maximum flexibility in planning to meet the needs of each child. The student work pages develop the major mathematical concepts. The Teacher's Guide offers a wealth of suggestions for the effective teaching of these concepts.

Organization of the Teacher's Guide

Each lesson is organized to develop specific concepts. The teaching goals are clearly stated in terms of desired learning outcomes for the child. The teacher will find it beneficial to refer to the *Objectives* as she makes her daily lesson plans and again as she evaluates the readiness of the child for the next step in the learning sequence.

Basic mathematical ideas which serve as background information for the teacher are presented in the *Fundamentals* section. Thorough understanding of these concepts should be considered as prerequisite to teaching each lesson. At the end of many of the *Fundamentals* sections, reference is made to those chapters in KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER in which the ideas are presented in greater depth and in relation to other ideas.

It is generally recognized that the greatest understanding comes when the child is ready for a particular concept. Before beginning each new lesson, the teacher should carefully evaluate the child's readiness for the concepts to be developed. The specific knowledge and skills needed for optimal achievement are listed under *Readiness for Understanding*. The teacher must be prepared to stop periodically to review and perhaps to reteach some of the concepts previously presented. She may wish to use this section to help in planning small-group activities and individual work.

Through many carefully-structured activities and guided discussions, the teacher can help the child develop an understanding of the concepts presented in each lesson. In the *Developmental Experiences* section, the teacher will find a variety of suggestions for leading the child from known concepts to the discovery of new ideas. Needed materials and vocabulary are listed, and specific directions are given for the use of the student work pages.

Experiences designed to strengthen and extend the child's understanding of the concept developed in the lesson are presented in *Supplemental Experiences*. Suggestions for integrating the arithmetic program with other areas of the curriculum are presented. No attempt has been made to label a particular activity "enrichment" or "remedial," for it has been found that what serves as review for one child may very well bring about initial understanding for another. The teacher must take the responsibility of selecting and adapting particular activities to meet the needs of her group.

The Kindergarten Program

The growth of mathematical concepts is an important part of the total growth of the Kindergarten child. The teacher will find that much of the understanding, skills, and enthusiasm developed by GCMP will serve the child well in other areas of the curriculum. As the search for new ideas and relationships becomes part of the child's thinking pattern, learning will indeed become an exciting adventure.

Points and Lines

Objective

To help children think about points and lines in their physical world.

Fundamentals

The five-year-old child has had many informal experiences with the geometry of the physical world. It seems natural, therefore, to initiate the kindergarten program with activities which encourage him to take a more critical look at points, lines, and shapes in his environment. Although he is not directly involved with mathematical geometry, the child will begin to abstract some of its basic concepts.

To the young child, a point may be the sharp end of a pin or a dot which designates a specific position. A line is a long thin mark on a paper, a piece of string, or anything physical which denotes a path. In the child's world, these lines all have a beginning and an end. He soon discovers that some special lines are called "straight" and others are called "curved." He becomes aware that the shortest line connecting two points is a straight line.

Readiness for Understanding

Ability to listen attentively.
Ability to follow simple directions.

Developmental Experiences

MATERIALS	VOCABULARY
yarn	point
	line
	straight
	curved

▶ Have the children sit in a group near the chalkboard. Say, "I am thinking of a very special *point* on the chalkboard. How can I show you which point I am thinking of? Yes, I can put my finger on it or I can draw a dot."

Draw a dot on the chalkboard. Help the children see that this point marks a specific position. Have the children take turns drawing other points on the chalkboard.

▶ Prick a paper several times with a pin. Talk about the different points represented by the pin holes.

▶ Draw two points on the chalkboard. Now connect the two points with a *line*. Demonstrate that there can be many lines between the two points.

Ask, "Do these lines all look alike? How are they different? Which is the longest line? Which is the shortest? Can you draw a longer line to connect these two points? A shorter line?"

▶ Introduce the terms *straight* and *curved*.

Make two pinholes in a paper. Discuss these points. Now make a series of pinholes very close together in a path connecting the two points. Talk about the line represented by this set of points.

Bring out a piece of yarn or heavy string. Have two children hold the ends of this line, pulling it taut. Ask, "Is this line straight or curved?"

Have one child let go of the yarn. Ask, "Is it straight now?"

Now have the other child drop the yarn on the floor. Again ask, "Is it straight now?"

▶ Discuss other lines about the room—the intersection of two walls, the border around the bulletin board, the frame of the window.

▶ Help the children discover that if they fold any piece of paper in two, the resulting crease will be a straight line.

Supplemental Experiences

▶ The following books will help reinforce the children's understanding of lines:

CROCKETT JOHNSON, *Harold and the Purple Crayon* (New York: Harper & Brothers, 1958).

LEONARD KESSLER, *What's in a Line?* (New York: William R. Scott, Inc., 1951).

▶ Play "Follow the Leader." Help the children see that they themselves form a line. This line can be straight or curved.

▶ Design string pictures. Dip pieces of colored string or heavy yarn in thin paste and arrange them on a piece of paper.

Dip a piece of string in poster paint; drop it on a piece of paper; fold the paper over and press. Remove the string and let the picture dry.

▶ Make point-and-line pictures. Have the children draw points on their papers and then draw lines connecting these points.

Circles

Objectives

To teach children to recognize circular shapes.

To teach children to associate the name "circle" with the appropriate shape.

Fundamentals

Four shapes or forms will be investigated in the kindergarten program: circles, squares and other rectangles, and triangles. This will be done, as with points and lines, entirely in the environment of the physical world with no attempt to give precise mathematical definitions. Interpret "circle" to mean both the closed curve (or border) and the interior of this curve (or the solid shape).

Display circles which are as nearly perfect as possible. Encourage the children to make their own descriptions of these circles.

Readiness for Understanding

Ability to recognize points and lines in the physical world.

Developmental Experiences

MATERIALS	VOCABULARY
flannel board	circle
felt circles of the same size	shape

▶ Hide a colored felt circle in an envelope, drawer, or treasure box. Send a child to see what he can find in the container. When the *shape* is found, place it on the flannel board and identify it as a *circle*. Help the children describe the shape with such phrases as "it is round," "it looks like a plate." Rotate the circle so the children note that it looks the same when viewed from different positions.

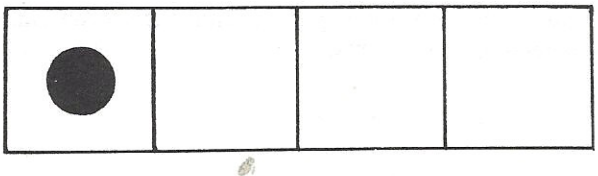
Display several other felt circles of the same size but of different colors. As you place each circle on the flannel board, have the children identify it by name and by color. Place one circle on top of another and discuss the idea of "the same size."

Fit a piece of yarn around one of the felt circles. Remove the shape leaving the outline. Lead the children to name this special closed curved line, "circle."

▶ Have the children point out circles about the room: the clock, doll plates, wheels on trucks.

Supplemental Experiences

▶ Start a bulletin board display of shapes. Divide a large bulletin board into four sections of the same size. Pin a large, colored-paper circle in the first section.



▶ Give the children paper on which one or more circles have been drawn. Have them color the circles or use them to make "circle pictures."

▶ Help the children learn to draw their own circles. As readiness for handwriting teach them to begin at the topmost point and extend their curved line down and around to the left. Encourage freedom of motion and large arm-movement by having them draw to music.

▶ Have the children draw, cut, and paste colored paper circles on a sheet of Manila paper or newsprint. To their delight, some of them will discover that if six circles of the same size are arranged in a circle, each touching its neighbor, another circle of the same size will just fit inside.

▶ Read books which deal with circles:

BLOSSOM BUDNEY, *A Kiss Is Round* (New York: Lothrop, Lee & Shepard Co., Inc., 1954).

CLIFF ROBERTS, *The Dot* (New York: Franklin Watts, Inc., 1960).

▶ Choose a child to point out any circle in the room as you sing to the tune of "Did You Ever See a Lassie?" Use the name of the child in the song.

Did you ever see a circle, a circle, a circle?
Did you ever see a circle?
Please show us one now.
O Mary, O Mary, O Mary, O Mary,
Did you ever see a circle?
Please show us one now.

▶ Play games in which children themselves form a circle: "Here We Go Round the Mulberry Bush," "Round We Go."

Squares

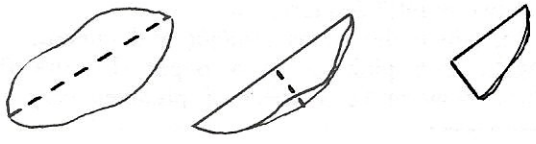
Objectives

To teach children to recognize square shapes.

To teach children to associate the name "square" with the appropriate shape.

Fundamentals

Many children will see, without having been given a precise definition, that the square has four sides and four corners. They may be able to tell you that the sides of the square are all the same size or the same length and that the corners are all the same. Do not refer to the corners or the sides as being "equal," since that word is to have a special meaning in work with numbers and should not be used here. They can use a simple paper strip to "measure" the lengths of the sides of the square. To compare the corners or angles they can use a model "square corner" from any piece of paper. This corner can be made by first folding a piece of paper along any straight line and then folding this crease onto itself.



Readiness for Understanding

Ability to identify circles.

Developmental Experiences

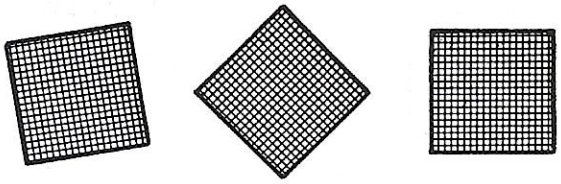
MATERIALS

flannel board
felt squares of the same size

VOCABULARY

square
side
corner

▶ The treasure box should now contain a felt square. As a child finds it, have him place it on the flannel board. Identify the shape as a *square* and lead the children to describe it. Help them see that the *corners* and *sides* are the same size. Have the square turned in different positions and named in each position.

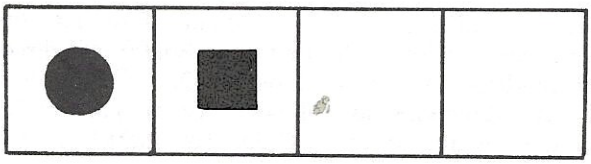


Present squares of different colors and have each one identified.

Have the children find squares in the classroom: floor tiles, table tops, pictures.

Supplemental Experiences

▶ Place a square shape in the second section of the bulletin board.



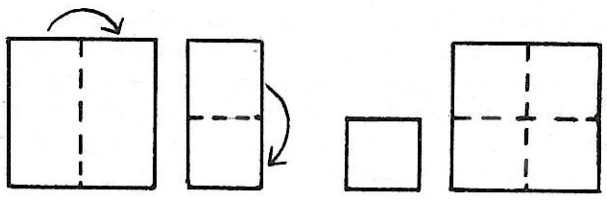
▶ To strengthen the children's awareness of shapes, read:

MIRIAM SCHLEIN, *Shapes* (New York: William R. Scott, Inc., 1952).

▶ Help the children learn to draw squares by using straight lines. They can then use these squares to make pictures.

Pass out squares of paper. Help the children fold their papers two times as illustrated.

They will be pleased to find more squares when they open their paper. Now have them draw a "square" picture in each box.



▶ Paste a brightly colored square at the top of one large piece of chart paper and a circle at the top of another. Provide old magazines from which the children can cut pictures containing circles and squares. These can then be pasted on the correct chart.

▶ Have one child point out a square in the room as the other children sing "Did You Ever See a Square?"

▶ Have the children draw squares to music which has 4/4 time. They may draw these squares in the air, on the chalkboard, or on large pieces of paper.

Circles and Squares

Work Pages K-1 and K-2

Objective

To evaluate children's ability to recognize circles and squares.

Fundamentals

In any learning situation it is well to pause often to summarize the concepts which have been developed. It is just as important to constantly evaluate the children's understanding of these concepts. The pupils' work pages are designed to fill both of these educational needs.

Most kindergarten children have had pleasant experiences with drawing and coloring. Their first experience with the work pages begins, therefore, with this familiar activity.

Readiness for Understanding

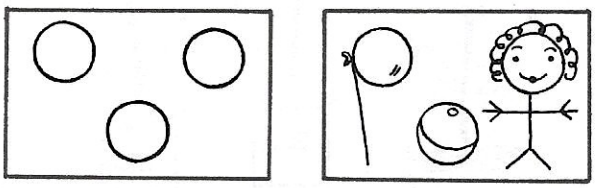
Recognition of circles and squares.

Recognition of the colors red, blue, green, and yellow.

Developmental Experiences

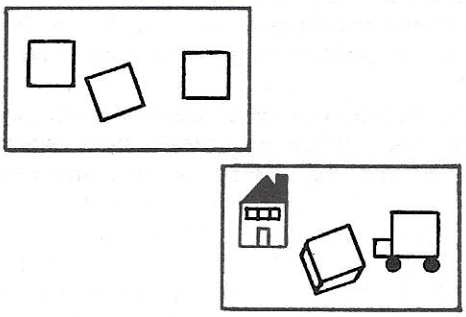
MATERIALS

crayons
colored chalk



▶ Draw two or three circles of the same size on a 24″ x 36″ piece of newsprint. Have the circles identified and discussed. Let the children help make pictures using these shapes.

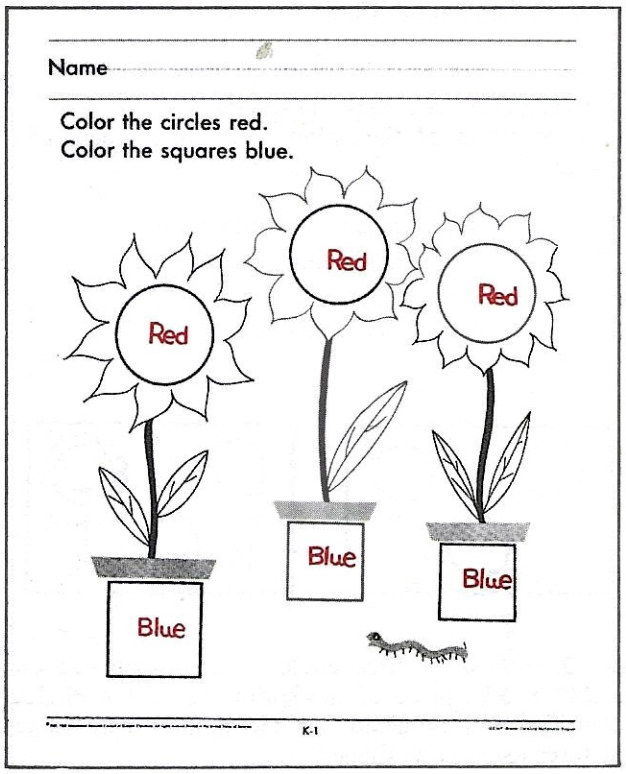
Draw two or three squares of the same size on another paper. Have them identified and discussed. Have the children help make pictures using these shapes.

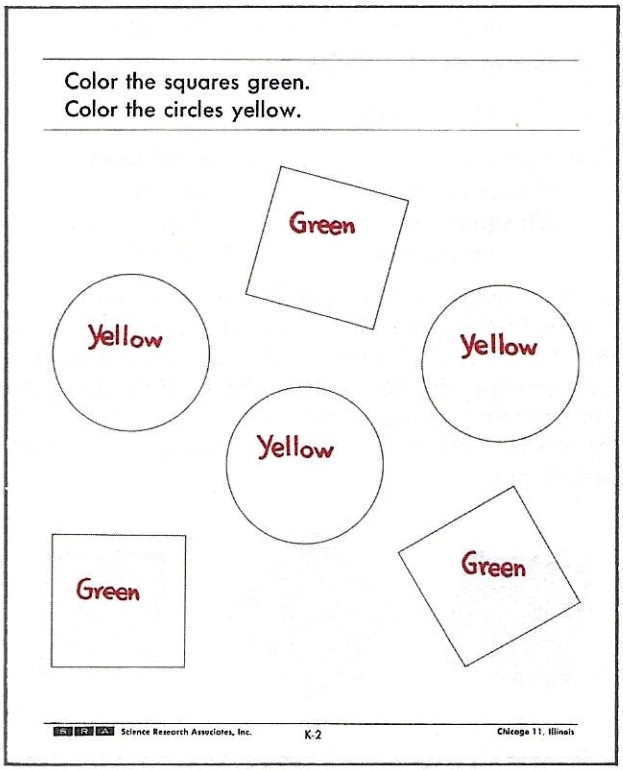


Draw both squares and circles on a third piece of paper. Again use the shapes to make simple pictures. Have a child come up and mark one of the circles with a red crayon. Have another child mark one of the squares with a blue crayon. Have children take turns marking the other shapes in the same way.

▶ Give each child work page K-1 on which his name has been written. Discuss the printed word "Name" and the name-line at the top of the page. Lead the children to talk about the picture and the shapes they find in the picture. Tell them that they are going to color these shapes in a very special way. If any child does not have the coordination to color, encourage him to mark the shapes with a line or an X.

Give directions as follows: "Color (or mark) all the circles red." "Color (or mark) all the squares blue."





Encourage children who are having difficulty; give them as much time and assistance as they need. As you collect the papers, tell the children that they will do the other side of the work page on another day.

▶ To prepare the children for work page K-2, draw several circles and squares on the chalkboard. Have the children take turns marking the shapes with two different colors of chalk. Pass out the work pages. Discuss the first page briefly and direct the children to turn to work page K-2.

Give directions as follows: "Color (or mark) all the squares green." "Color (or mark) all the circles yellow."

Move among the children giving help and encouragement where needed.

You may want each child to take his first work page home now, or you may prefer to save it for inclusion in individual books about shapes.

Supplemental Experiences

▶ For those children who need extra help, review the flannel-board work with shapes. Provide individual help with sets of cutouts of paper circles and squares. Have the child identify each cutout and place it in a pile with others of the same shape.

▶ Hide heavy cardboard or Masonite circles and squares in a box or bag. Have a child stand with his back to the box and reach in to choose a shape. Have him keep the cutout behind his back, feel it carefully, and guess what shape he is holding.

▶ Have the children cut and paste colored-paper squares and circles on a piece of Manila paper to make pictures and designs.

Comparative Size

Work Page K-3

Objective

To develop an understanding of size relationships.

Fundamentals

When comparing any two objects in regard to size, one of three relationships exists.

1—The first object may be the same size as the second. In such a case the second object is the same size as the first.

2—The first object may be larger than the second. In such a case the second object is smaller than the first.

3—The first object may be smaller than the second. In such a case the second object is larger than the first.

In the kindergarten, comparisons should be made by using pairs of objects whose differences in size can be easily determined by visual inspection. Making use of circles and squares for investigating size relationships will help reinforce the children's concepts of these shapes.

Readiness for Understanding

Ability to recognize circles and squares.

Developmental Experiences

MATERIALS

flannel board
felt circles of 2 different sizes
felt squares of 2 different sizes
colored chalk
crayons

VOCABULARY

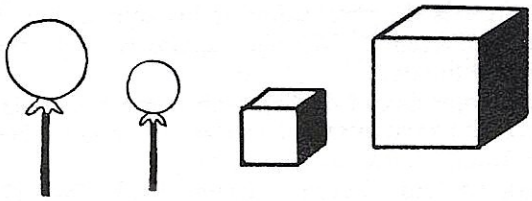
larger than
smaller than
the same size as

▶ Hide two felt circles in the treasure box. As they are found, place them on the flannel board and have them identified. Discuss the ways (shape, color, and size) in which the circles are alike. Introduce the term *the same size as*. Replace one circle with a larger circle of the same color, and help the children discover that although the circles are the same in color and shape, they are different in size. Introduce the terms, *larger than* and *smaller than*, and have the children describe each circle in terms of the other. Change the positions of the circles on the flannel board and have them described again.

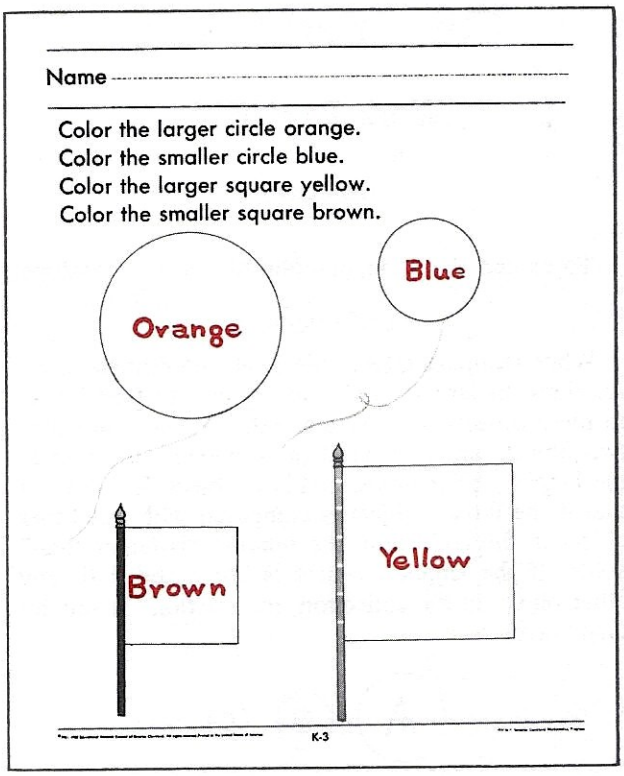
Continue making comparisons with circles of other colors. Encourage the children to verbalize each situation in such terms as "the red circle is larger than the yellow circle," "the blue circle is larger than the yellow circle," "the red circle is the same size as the blue circle."

Repeat the flannel-board activity. Use felt squares of two sizes and of different colors.

▶ Draw two circles and two squares of different sizes on the chalkboard. Have the children take turns pointing to the larger circle, the smaller square, and so forth. Now have one child mark the smaller circle with red chalk, another child mark the larger square with blue chalk, and so forth. Repeat the activity with pictures of lollipops and square-shaped boxes. Help the children think of the shapes in these pictures.



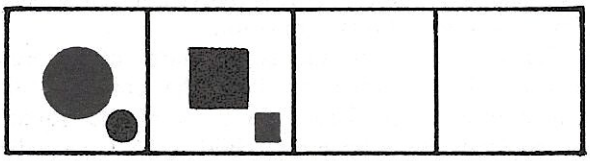
▶ Distribute work page K-3. Direct the children: "Put your finger on the larger circle (balloon)." Be sure each child has found the correct circle. Continue: "Put your finger on the larger square." Have the children repeat the activity for the other two figures as well, and give these directions for marking the shapes: "Color (or mark) the larger circle orange. Color (or mark) the smaller circle blue. Color (or mark) the larger square yellow. Color (or mark) the smaller square brown."



Supplemental Experiences

▶ In the first section of the bulletin board place a circle different in size from the circle already there.

Complete the second section with a square of a different size.



▶ Hide circles and squares of two different sizes and of many different colors in a bag or box. Have a child pull a shape from the collection and name and describe it. Now have a second child select a shape, name it, and compare it to the first shape. "My circle is the same color as his square, but the shape is different." "My blue square is larger than her yellow square."

Read some books dealing with comparative size:

PHYLLIS KRASILOVSKY, *The Very Little Girl* (New York: Doubleday & Co., Inc., 1953).

CHARLES and MARTHA SHAPP, *Let's Find Out What's Big and What's Small* (New York: Franklin Watts, Inc., 1959).

ETHEL S. BERKLEY, *The Size of It* (New York: William R. Scott, Inc., 1950).

▶ Give each child a paper on which a circle and a square have been drawn. Direct the children to draw a circle which is larger (or smaller) than the one already there. Have them draw a larger (or smaller) square. Now let them color the shapes.

Comparative Size

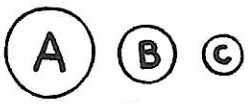
Work Page K-4

Objective

To extend the understanding of size relationships.

Fundamentals

When comparing two objects of different sizes, the relations "is larger than" and "is smaller than" refer to these objects in a certain order. When more than two objects are compared, it is possible to refer to the largest object or the smallest object. This means that if the largest object is compared with any other object in the collection, the relation "is larger than" holds. If the smallest object is compared with any other object in the collection, the relation "is smaller than" holds.



In comparing circles A, B, and C, circle A is the largest circle and circle C is the smallest. Circle B is smaller than circle A and, at the same time, is larger than circle C.

Readiness for Understanding

Understanding of the size relationships "is larger than," "is smaller than," and "is the same size as."

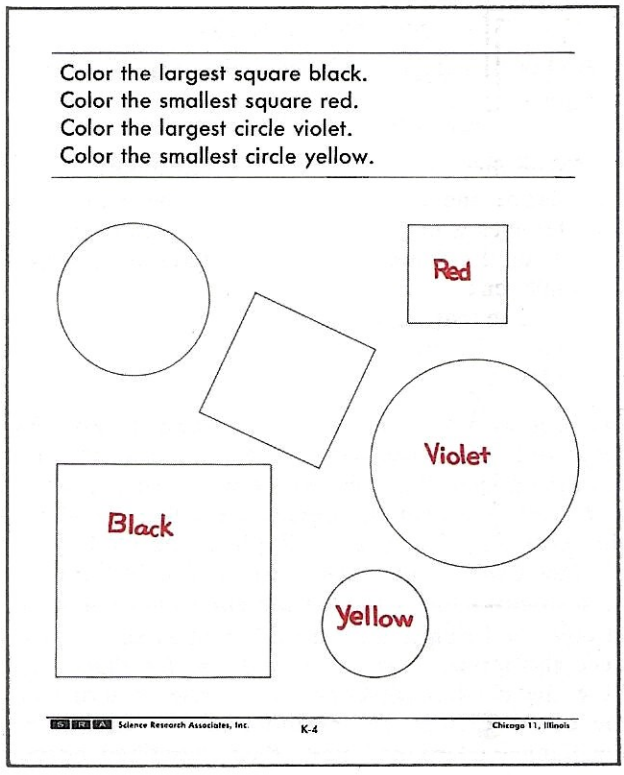
Developmental Experiences

MATERIALS	VOCABULARY
flannel board	largest
felt circles and squares of 3 different sizes	smallest
colored chalk	
crayons	

▶ Display, on the flannel board, three felt circles of different sizes but of the same color. Discuss the difference in size. Introduce the terms *largest* and *smallest*. Bring out circles of other colors and continue making comparisons.

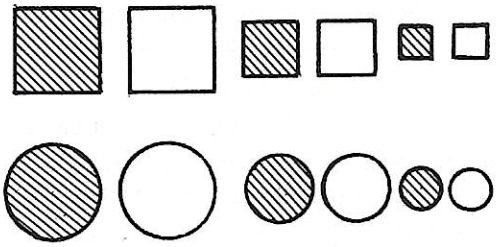
Repeat the activity with squares of different sizes and colors. Draw circles and squares of three different sizes on a large piece of newsprint or on the chalkboard. Have the children take turns pointing out the largest circle, the smallest circle, and so forth. Now have one of the children put a blue mark on the smallest square, another put a green mark on the smallest circle, and so forth.

▶ Pass out work page K-4. Give these directions for marking: "Color (or mark) the largest square black. Color (or mark) the smallest square red. Color (or mark) the largest circle violet (or purple). Color (or mark) the smallest circle yellow."

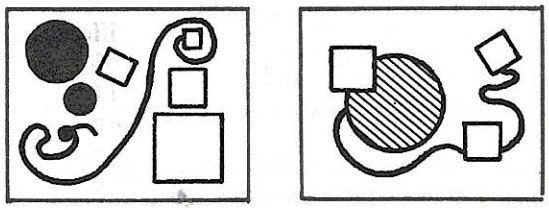


Supplemental Experiences

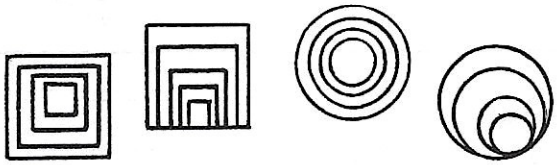
▶ Prepare several individual sets of cardboard or heavy paper-cutout shapes. Encourage the children to manipulate these shapes, and to compare and to match them.



▶ Making designs with cutout shapes of different sizes and colors is fun. Include the use of string in these designs to show different kinds of lines. Have the children take turns describing their pictures. Encourage them to use such terms as "larger than," "the same size as," "smallest," and so forth.

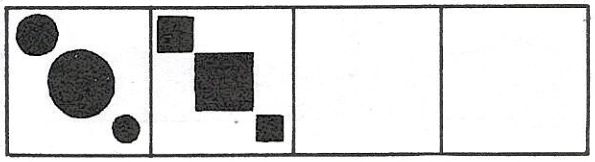


Have the children draw or paste pictures of circles within circles and squares within squares. Now have them point out the largest and smallest shape in each picture.



▶ Place three circles of different sizes on the chalk tray. Have one child examine the circles and then hide his eyes while another child changes their order. Now have the first child open his eyes and try to replace the circles in their original order. Use squares in the same way, or mix circles and squares.

▶ Place another circle in the first section of the bulletin board so that three sizes are now displayed. Complete the second section with a third square.



Rectangles

Objectives

To teach children to recognize rectangular shapes.

To teach children to associate the name "rectangle" with the appropriate shape.

Fundamentals

The rectangle, like the square, has four square corners and four sides. In both, pairs of opposite sides are the same size or length. In the rectangle, however, one pair of opposite sides may differ in size from the other pair. Every square is a rectangle, but not every rectangle is a square.

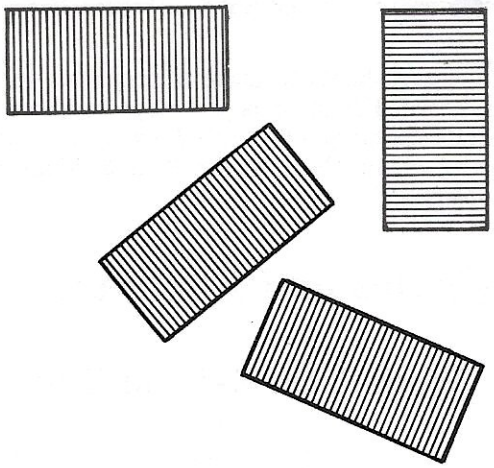
Readiness for Understanding

Ability to identify and describe squares.

Developmental Experiences

MATERIALS	VOCABULARY
flannel board	rectangle
felt rectangles	

▶ Arrange for the children to find a felt rectangle in the treasure box. Place the shape on the flannel board and identify it as a *rectangle*. As with the square, present the rectangle in different positions.



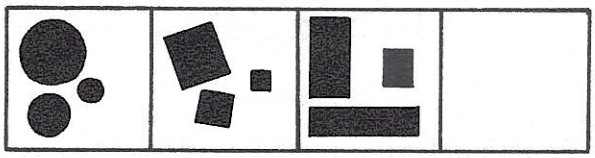
Use the folded paper "square corner" to determine whether the corners of the rectangle are the same size. Simple paper strips may be used to show that opposite sides of the rectangle are the same length.

Present other rectangles which differ in size and color. Have the children name them and discuss how they are the same as, or different from, the first rectangle.

Have the children point out rectangles around the room.

Supplemental Experiences

▶ Display rectangles of three different sizes in the third section of the bulletin board.



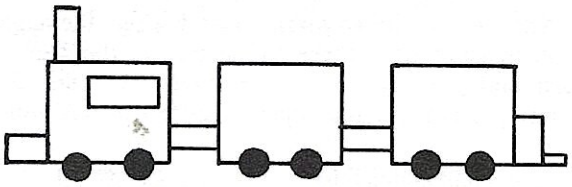
▶ Sing, "Did You Ever See a Rectangle?"

▶ Continue to have the children use the sets of cutout shapes. Include rectangles of various sizes and colors. Have the children match, compare, and sort these shapes.

Arrange three circles and one rectangle on the table. Ask a child to point out the shape which is different from the others. Repeat the activity using cutouts of the same shape but having one which differs in size or color.

▶ Have the children use pegs on peg boards and experiment with making outlines of various shapes. Colored rubber bands can be stretched around the pegs to outline the shapes.

▶ Have the children draw rectangles and use them to make pictures of trains, trucks, cars, busses, houses, books, and people.



▶ Use cutout shapes to make a large train for the bulletin board. Fill the cars with toys and packages to illustrate the story *The Little Engine That Could,* ed. WATTY PIPER (New York: Platt & Munk Co., Inc., 1954).

Circles and Rectangles

Work Pages K-5 and K-6

Objectives

To evaluate the children's ability to recognize circles, and squares and other rectangles.

To evaluate the children's understanding of terms for comparative size.

Fundamentals

The teacher will now want to tie together the skill and understanding developed up to this point in the program. She will want to give the children an opportunity to display what they have learned about circles, squares, and rectangles. Constant evaluation of the children's progress will help the teacher plan wisely the experiences which will be most beneficial to her particular class.

Readiness for Understanding

Ability to recognize circles, and squares and other rectangles.

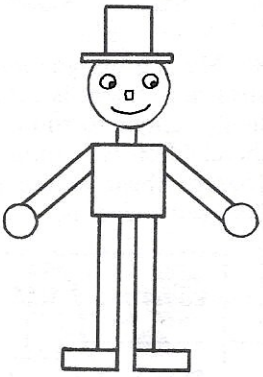
Understanding of comparative size terms.

Developmental Experiences

MATERIALS

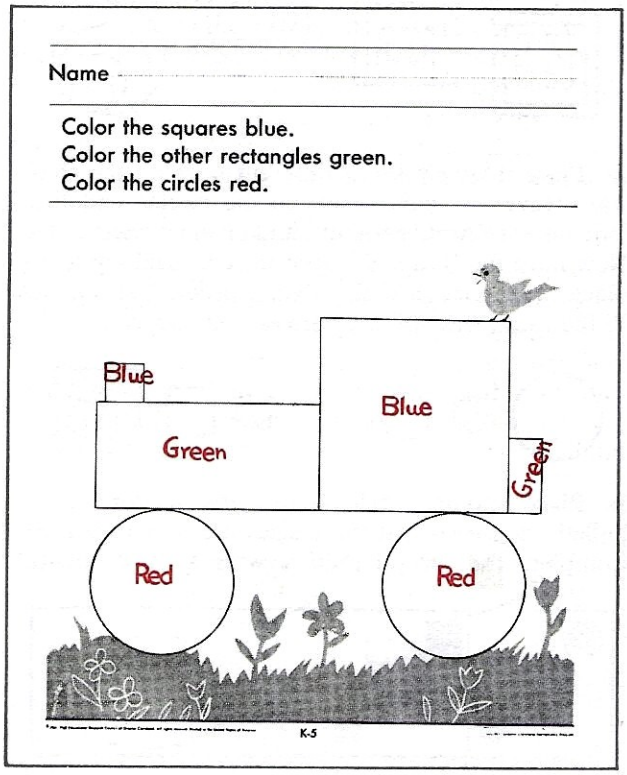
colored chalk
felt shapes

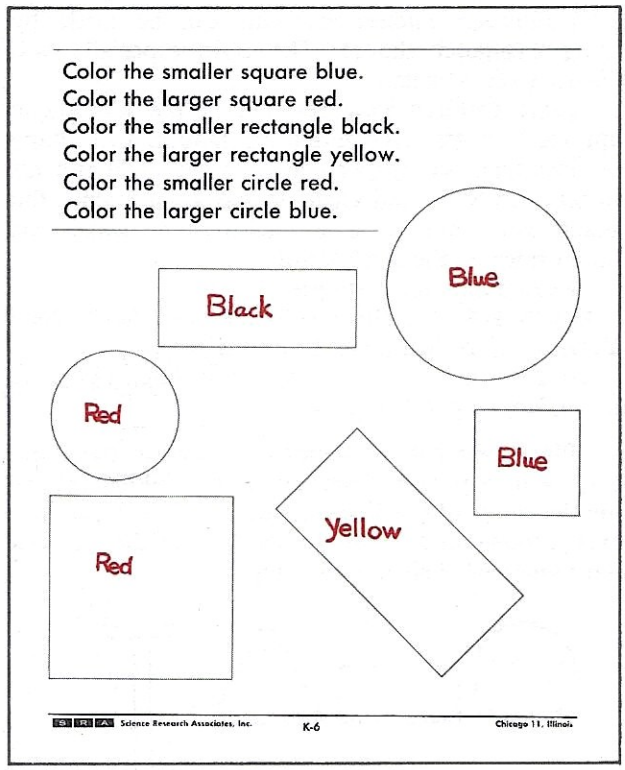
▶ On the chalkboard draw a picture of a man. Use circles, and squares and other rectangles. Have the various shapes pointed out and discussed. The children can tell what shapes they see and point them out. After a discussion have all the circles colored with red chalk, all the squares colored with blue chalk, all the rectangles colored with yellow chalk. Repeat the activity with other pictures composed of circles, and squares and other rectangles.



▶ Use work page K-5. Discuss the picture of the engine. Ask the children what different shapes they see in the engine. Direct them to color the engine a special way by saying, "Color the squares blue. Color the other rectangles green. Color the circles red."

▶ Place on the flannel board, two circles of different sizes, two rectangles (which are not squares)





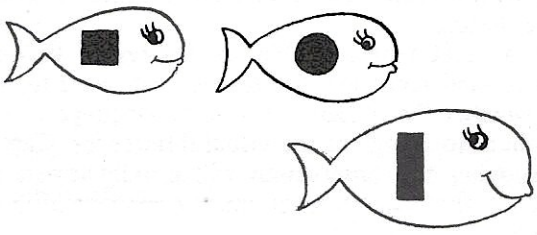
of different sizes, and two squares of different sizes. Ask one of the children to find the *larger* rectangle that is not a square. If he is successful, he may name and describe a shape, and choose another child to find it. Continue as long as interest is sustained.

▶ Prepare the children for work page K-6. On the chalkboard draw two circles, one *smaller* than the other. Have the smaller circle marked or colored with red; have the larger circle colored or marked with blue. Repeat with drawings of two squares and of two rectangles which are not squares.

Present the work page with the following directions: "Color the smaller square blue. Color the larger square red. Color the smaller rectangle black. Color the larger rectangle yellow. Color the smaller circle red. Color the larger circle blue."

Supplemental Experiences

▶ Have the children play "Fish Pond." Cut out paper fish; draw a shape on each. Place a paper clip or steel staple on each fish. Construct a fishing pole from a stick, string, and magnet. As each child catches a fish, he must name the shape on it and place it on a cardboard frying pan which bears a similar shape.



Triangles

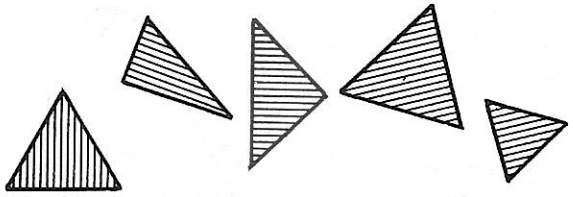
Objectives

To teach children to recognize triangular shapes.

To teach children to associate the name "triangle" with the appropriate shape.

Fundamentals

Introducing the triangle to children presents a special problem, that of using a single name to represent many shapes that are visually dissimilar. Here, as with the other shapes, the primary objective is rapid recognition of the particular shape, rather than the identification of special properties. It is important to expose the children to a great variety of triangular shapes and refer to each as a triangle. The children should be encouraged to make their own descriptions of these triangles.



Readiness for Understanding

Ability to recognize circles, squares, and rectangles.

Developmental Experiences

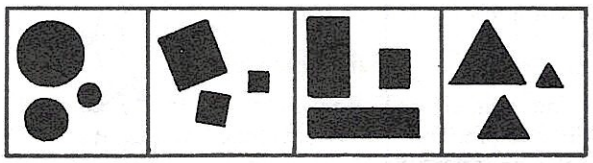
MATERIALS	VOCABULARY
felt triangles	triangle

▶ Hide a felt *triangle* in the treasure box. When the triangle is discovered, have it placed on the flannel board and give it a name. Move it around to show how it looks in different positions. Display triangles of different types, sizes, and colors. Have them identified and compared as they are placed on the flannel board.

See if any triangles can be found around the room.

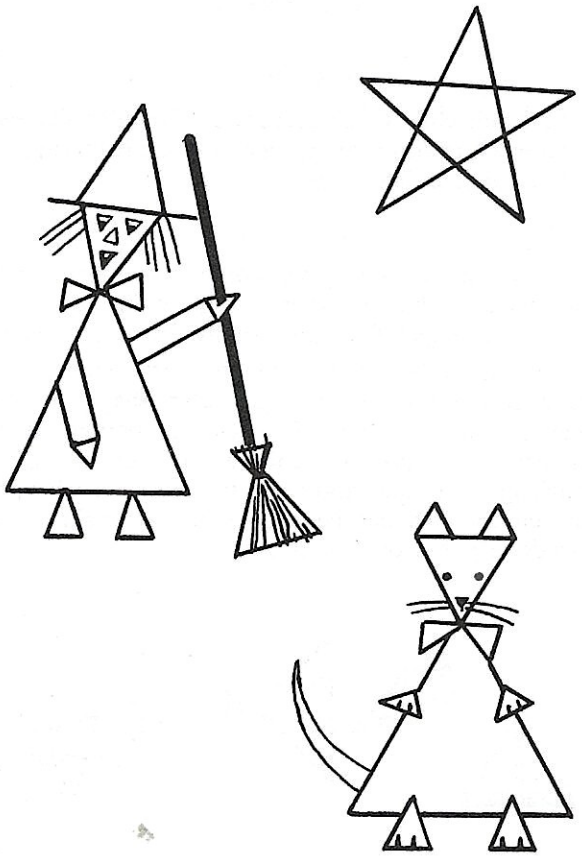
Supplemental Experiences

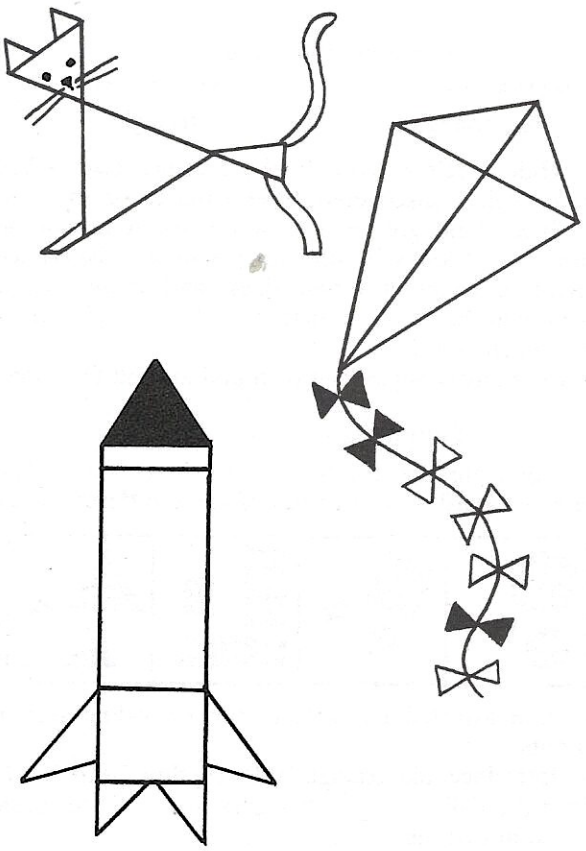
▶ Complete the fourth and final section of the bulletin board with triangles of three different sizes.



▶ Add assorted triangles to the individual sets of cutouts.

▶ Introduce the triangle into rhythm band work. Have the children draw triangles in the air to music played in ¾ time.





▶ Halloween witches and cats can be made by using triangular shapes. The boys especially will like to make rockets.

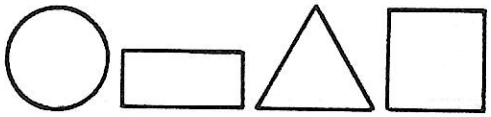
▶ Some children may respond to the kinesthetic approach in the recognition of shapes. Cut shape outlines from sandpaper and have the child rub his fingers gently around each outline as he names the shape. Have him trace around a shape which has been drawn on the chalkboard.

Read books about shapes:

HELEN BORTEN, *Do You See What I See?* (New York: Abelard-Schuman, Ltd., 1959).

ED EMBERLEY, *The Wing on a Flea* (Boston: Little, Brown and Co., 1961).

▶ Place four cutout shapes in a row on the chalk tray or in a pocket chart. Have the children examine the order of the shapes. Now, as they close their eyes, remove one of the shapes. One of the children must guess what shape is missing.



▶ Arrange four cutout felt shapes in a row on the flannel board. Hold up a duplicate of one of the cutouts. The child must find the shape which is the same. As a variation, have three of the four shapes alike. Have the child point out the shape which is different and say its name.

Circles, Rectangles, and Triangles

Work Pages K-7 and K-8

Objective

To evaluate the children's ability to recognize the four basic shapes.

Fundamentals

Once again the teacher will want to take stock of the children's understanding of the ideas presented thus far in the program. She will want to give them an opportunity to have a sense of success as they demonstrate their ability to recognize the four basic shapes.

If a child seems unable to distinguish between triangle and rectangle, the teacher will want to find out whether the difficulty is one of language or one of failure to recognize the visual differences. Careful questioning and observation will usually reveal the area in which the teacher must provide additional help for the child.

Readiness for Understanding

Ability to recognize circles, squares and other rectangles, and triangles.

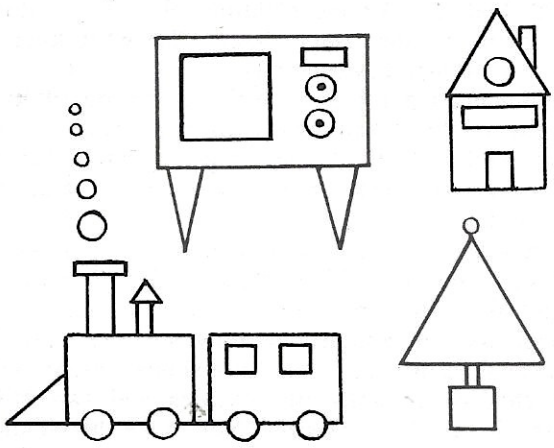
Developmental Experiences

MATERIALS

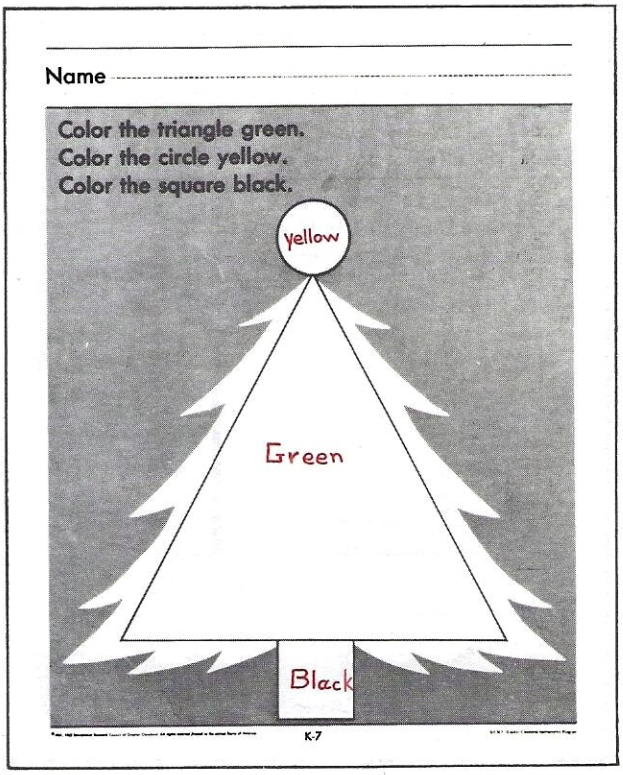
felt shapes
colored chalk

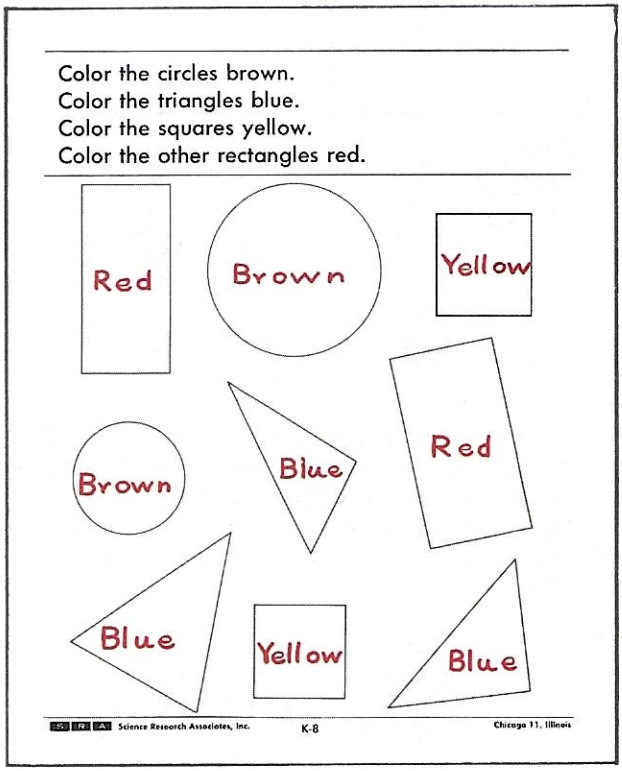
▶ Use felt cutouts on the flannel board to review the four basic shapes. Have the shapes identified and their sizes compared.

▶ On the chalkboard draw some pictures which contain two or more of the basic shapes. Have the various shapes marked or colored.



▶ Discuss the picture on work page K-7. Give these simple directions for marking: "Color the triangle green. Color the circle yellow. Color the square black."





Work page K-8 can be completed immediately after work page K-7, if the children find work page K-7 very easy to do. If necessary, do this page at a later time and precede its use with further review of the shapes. Direct the children to mark the shapes by saying, "Color all the circles brown. Color all the triangles blue. Color all the squares yellow. Color all the other rectangles red."

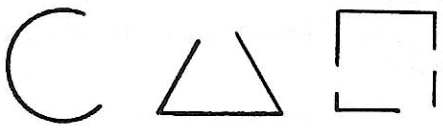
Supplemental Experiences

▶ Use the "Fish Pond" idea for the children who need help in recognizing the various shapes.

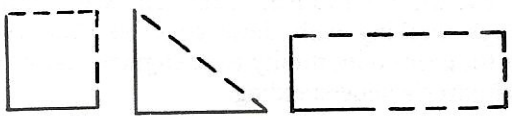
▶ Play "I Spy" in the class, where the answer must be circle, square, rectangle or triangle.

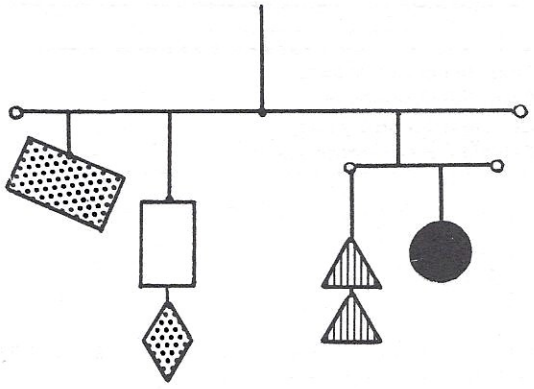
▶ Have children try painting the various shapes. Designs of definite objects, such as houses or trucks, can be painted after the children have had some practice painting the shapes.

▶ On the chalkboard draw part of a shape. Encourage the children to visualize the total shape. Have a volunteer draw what is needed to complete the shape.



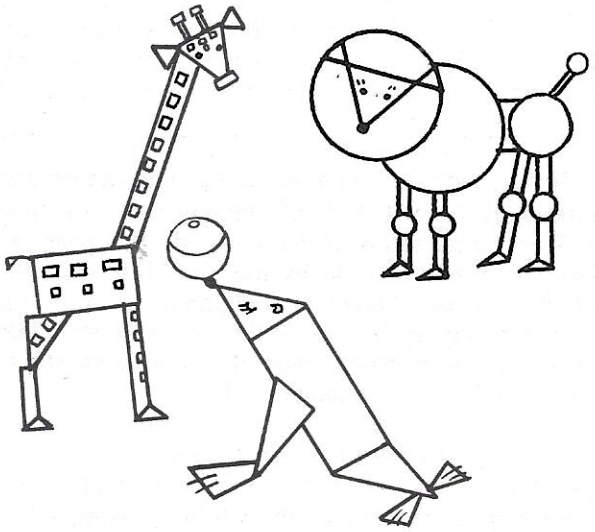
Some drawings should allow a choice of method for completion.





▶ Cut out paper shapes to construct a large mobile for the classroom or smaller ones for the children to take home. Have each shape identified.

▶ Modernistic animals can be made using cutouts of various shapes. Children can create their own animals.



Shapes and Sizes

Work Pages K-9 and K-10

Objectives

To evaluate children's ability to recognize the basic shapes.

To evaluate children's ability to perceive differences in size.

Fundamentals

Before leading the children to new concepts, the teacher will want to be sure that they thoroughly understand the concepts of shape and of comparative size. She will want to help them build self-confidence through working with these concepts. She will be alert for every opportunity to strengthen and broaden the children's understanding.

Readiness for Understanding

Understanding of terms denoting comparative size.

Ability to identify four basic shapes.

Developmental Experiences

MATERIALS

felt cutouts
colored chalk

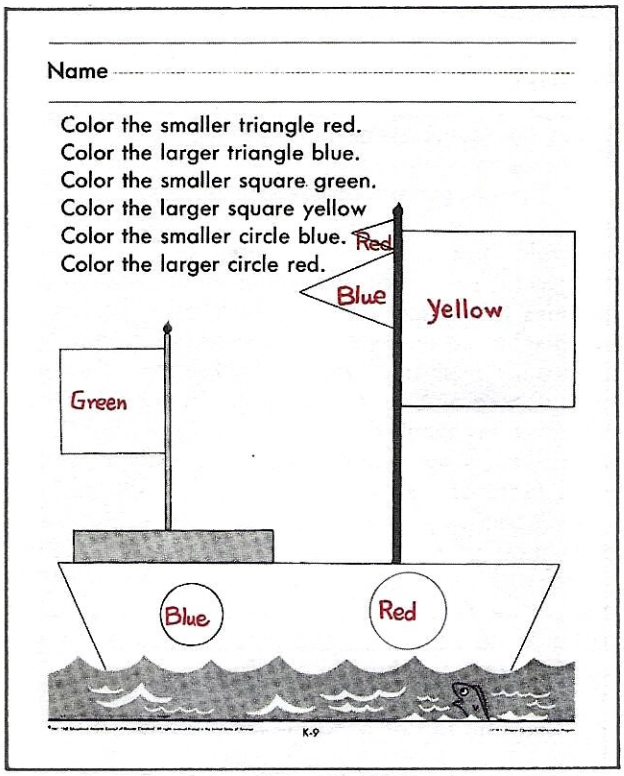
▶ Have a child arrange the felt cutouts on the flannel board to form a picture. Have the various shapes described and pointed out by another child.

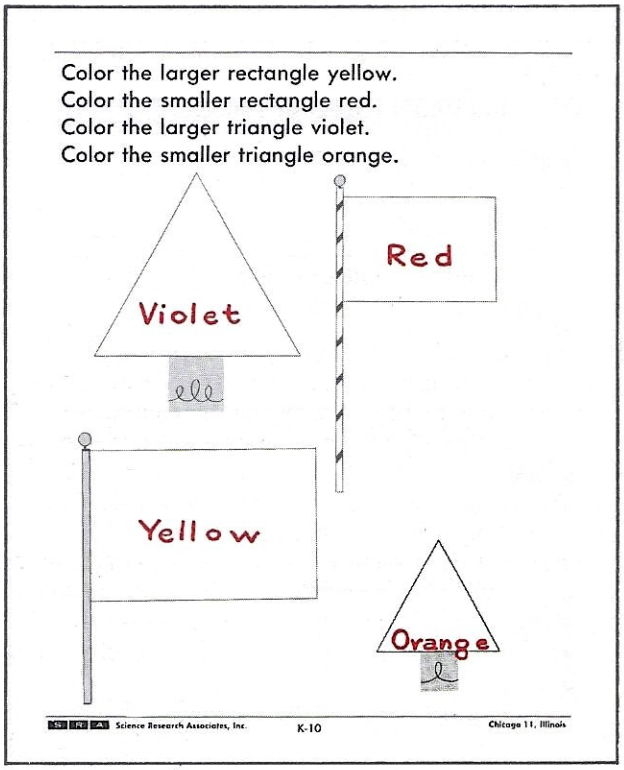
As a variation, pass out several cutouts, one to each child, and let the children take turns putting the shapes on the flannel board. See what kind of object or design they can make.

After making a picture on the flannel board, have all the circles taken away, all the squares taken away, and so forth. If one shape remains after the others are removed, have it named by a child and removed.

▶ Ask a child to draw a triangle on the chalkboard. Direct a second child to draw a triangle which is larger than the first. Have another child draw a circle; ask still another to draw a circle which is smaller than the first circle. In a similar fashion lead the children to draw two squares and two other rectangles of different sizes. Now have the children take turns marking the different shapes with colored chalk.

▶ Pass out work page K-9. Have each child's name written on the line designated for it. Discuss the picture.





In order to evaluate more carefully the progress of each child, it may prove helpful to work with a small group at a time on this work page.

Give these directions for marking: "Color the smaller triangle red. Color the larger triangle blue. Color the smaller square green. Color the larger square yellow. Color the smaller circle blue. Color the larger circle red."

After a brief discussion about the pictures on work page K-10, give directions by saying, "Color the larger rectangle yellow. Color the smaller rectangle red. Color the larger triangle violet (purple). Color the smaller triangle orange."

Supplemental Experiences

▶ Hold up a heavy, paper-cutout shape. Have one of the children touch something in the room which contains this shape. Continue with other shapes.

▶ Display a circle, square and other rectangle, and triangle on the flannel board. Name an object in the room and have a child point out the shapes contained in this object.

▶ Stage a shape relay. Scatter a variety of shapes on a table at one side of the room. Choose two teams. Name a shape. The first child from each team must go to the table and find a sample of the shape which has been named. If he is correct, he goes to the end of his line. Name a different shape to be found by the second pair of contestants, still a different for the third, and so forth.

▶ Play a guessing game. Ask riddles such as, "I look like the top of a drum. What shape am I?" or "I have three sides. What shape am I?"

Shapes and Sizes

Work Pages K-11, K-12, K-13, and K-14

Objectives

To evaluate the child's ability to recognize basic shapes and perceive differences in size.

To help children develop left-to-right eye movement.

To help children learn to work from the top row to the bottom row.

Fundamentals

In helping children develop readiness for more formal work, the skillful teacher will make the most of each learning situation. Reading-readiness skills can often be developed along with the arithmetic program just as number-readiness grows during music, art, and story periods.

An understanding of the concept of row is extremely important. On many of the work pages from this point on, children will do the work by rows. They must learn to work across the row from left to right and also down the page, row by row, from top to bottom. The introduction and development of top-to-bottom and left-to-right eye movement can be correlated with the reading-readiness program.

Readiness for Understanding

Ability to follow simple directions.

Ability to recognize the four basic shapes.

Understanding of terms denoting comparative size.

Developmental Experiences

MATERIALS	VOCABULARY
colored chalk	row
large sheets of paper	first
crayons	next
felt cutouts	last
flannel board	

▶ Draw a square, a circle, and a triangle in a row on the chalkboard. Explain the term *row*. Draw a dot or star at the left of the row so the children will know where to start. Talk about the position of each shape in the row. Use the terms, *first, next,* and *last*. Have a child mark the square and describe its position in the row. Draw other rows of shapes. Have one shape marked in each row.

▶ Place felt cutouts in rows on the flannel board. Talk about the first, next, and last shapes in each row. Ask different children to point to specific shapes in each row.

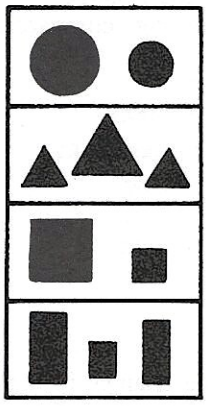
Direct one child to place a circle on the flannel board. Have another child place a square next, and have still another child place another rectangle last in the row. Ask a fourth child to point out a specific shape or remove it from the row.

▶ Distribute work page K-11. Introduce the Happy Helper who appears in a different hat at the beginning (left) of each row. Explain that he will help the children know where to look on the page. He will help them find the correct row.

Ask the children to point to the Happy Helper wearing the baseball cap. Now direct them to look at the shapes in this row. Ask what shape is first, what shape is next, and what shape is last in this row. Now tell the children to mark the circle.

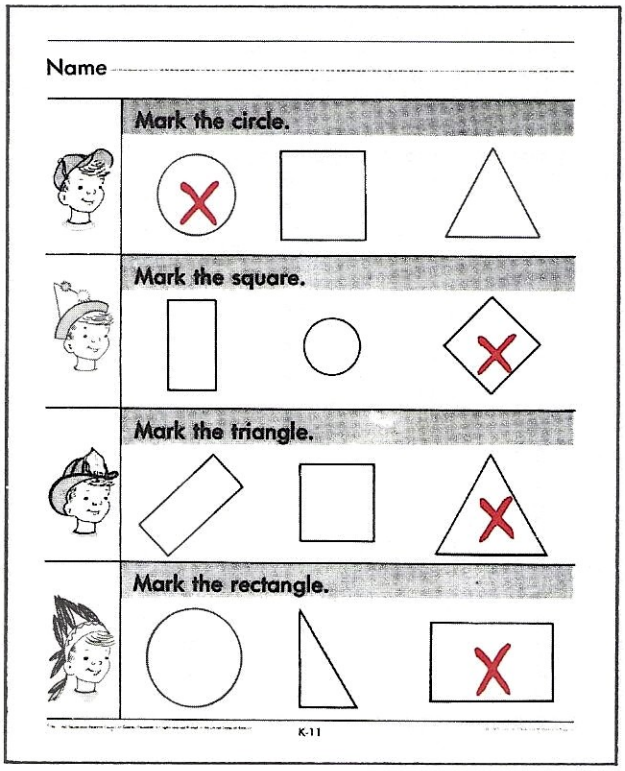
Check to make sure that the children have been able to follow the directions. Next, have the children point to the Happy Helper wearing the clown hat. Tell the children to mark the square in this row. After this, have them point to the Happy Helper wearing the fireman's hat, and direct the children to mark the triangle in his row. Finally, have them point to the Happy Helper wearing the Indian headdress. Have the children mark the rectangle in his row.

▶ To prepare the children for work page K-12, review the meaning of terms denoting comparative size. Divide a large piece of chart paper into several rows. In the first row, draw two circles, one larger than the other. Have a child come forward and point to the larger circle. Have another child mark the smaller circle. In the second row draw two triangles of the same size and one which is larger. Have a child come up and mark the triangles which are the same size. Have a second child tell whether the other triangle is larger or smaller than those which were marked. Continue the activity with rows of squares and other rectangles.

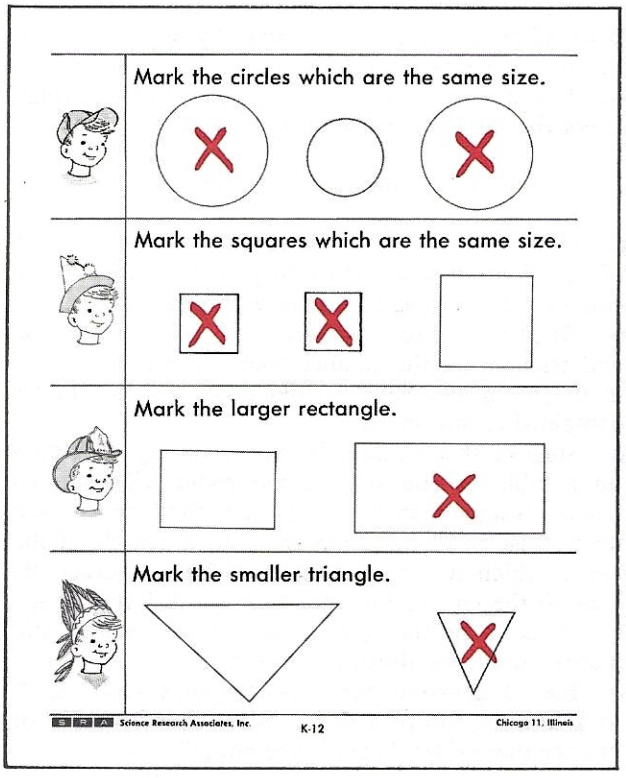


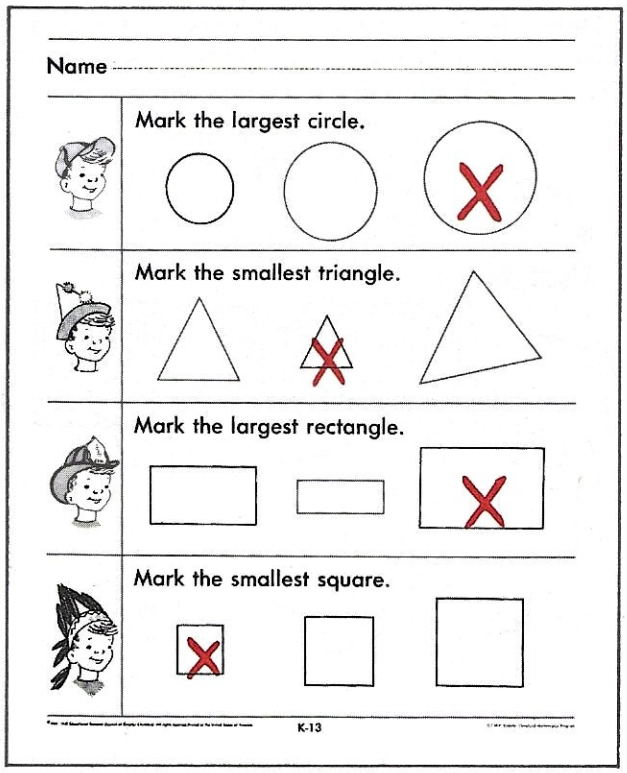
▶ Pass out work page K-12. Call attention to each Happy Helper in turn, to help the children find the correct row. Give directions carefully by telling the children, "Mark the circles which are the same size. Mark the squares which are the same size. Mark the larger rectangle. Mark the smaller triangle."

▶ Prior to using work page K-13, display cutout circles of three different sizes. Have the sizes compared and discussed. Review the terms "largest" and "smallest." Repeat the activity; use squares, other rectangles, and triangles of three different sizes. Give directions for the work page. Do not forget to use the Happy Helper as you say, "Mark the largest circle. Mark the smallest triangle. Mark the largest rectangle. Mark the smallest square."



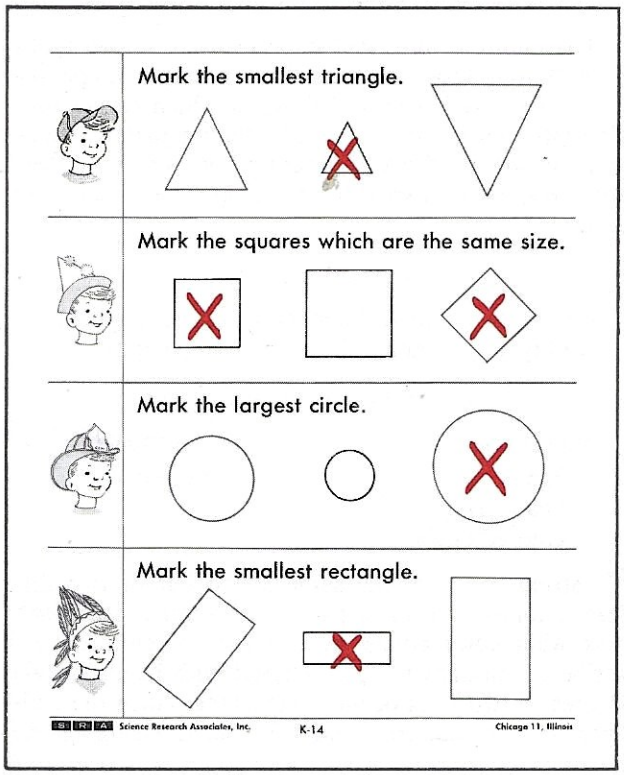
Work page K-14 probably can be completed at the same time as work page K-13. Follow the same procedure in giving directions, telling the children, "Mark the smallest triangle. Mark the squares which are the same size. Mark the largest circle. Mark the smallest rectangle."


Mark the circles which are the same size.
Mark the squares which are the same size.
Mark the larger rectangle.
Mark the smaller triangle.
SRA Science Research Associates, Inc.
K-12
Chicago 11, Illinois



Supplemental Experiences

▶ On papers which have been folded to form four horizontal sections have the children draw their own rows of shapes. They can exchange papers and work in pairs to give each other directions for marking the shapes.


Mark the smallest triangle.
Mark the squares which are the same size.
Mark the largest circle.
Mark the smallest rectangle.
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K-14
Chicago 11, Illinois

Patterns

Work Page K-15

Objectives

To give the children experience in pattern recognition.

To teach children to extend a given pattern.

Fundamentals

Pattern can be defined as an arrangement of parts, elements, or details that suggest a design or orderly distribution. The children's first experiences are with visual patterns. These experiences include the arrangement of such concrete objects as beads, pegs, blocks, and, later, pictures.

In the beginning the children are asked to extend simple patterns composed of like elements repeated over and over. When two different types of elements are included, an alternating pattern results.

Readiness for Understanding

Ability to perceive likenesses and differences.
Ability to recognize circles and squares.

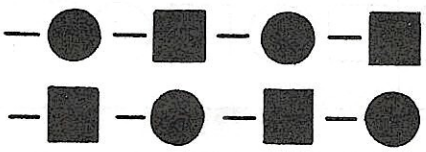
Developmental Experiences

MATERIALS	VOCABULARY
beads, both round and cubed	pattern
bead strings	repeat
	next

On the table, spread five round beads and five cubed beads of the same color. Encourage the children to comment that the beads have different shapes. String four of the round beads; ask the children to name the shape of each as it is put on the string. Ask a volunteer which bead should be *next*. Ask if any of the remaining beads belong on this string of round beads.

Discuss the *pattern* which is displayed. Repeat the procedure: string four of the cubed beads, which the children may refer to as square beads, and ask which bead comes next. Again discuss the pattern. Now string three round beads and three cubed beads; alternate the two shapes. Ask what shape comes next, and next.

▶ On the chalkboard draw a picture of a string of four round beads or a row of four circles. Have a child draw the shape that comes next. Repeat with a row of squares. Using these two different shapes, show two possible alternating patterns. Help the children *repeat* the patterns by drawing two more shapes in each row.



▶ Pass out work page K-15. Remind the children that the Happy Helper will help them find the correct row. Give directions for the first row.

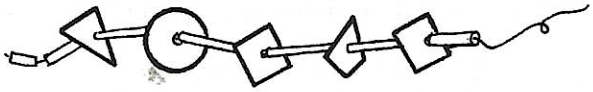
Tell the children to find the Happy Helper with the baseball cap on his head, to look at the row of shapes, and to think about the pattern these shapes make. Then tell them to draw the shape that comes next.

Give similar directions for the second row. For the third and fourth rows, encourage the children to draw the next shape, and then the next shape.

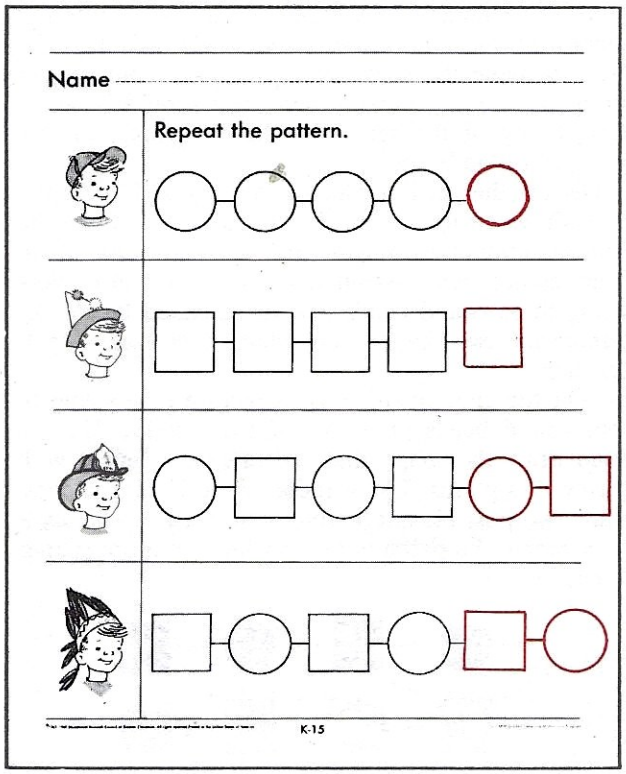
Supplemental Experiences

▶ Many first experiences with pattern are auditory. In rhythm work make use of many different patterns evident in the meter of walking, galloping, or skipping. Let the children create their own rhythms. Have them clap or tap to different rhythmic patterns. Play music of the same rhythm but of varying degrees of loudness. Point out the repeat-phrases in simple songs.

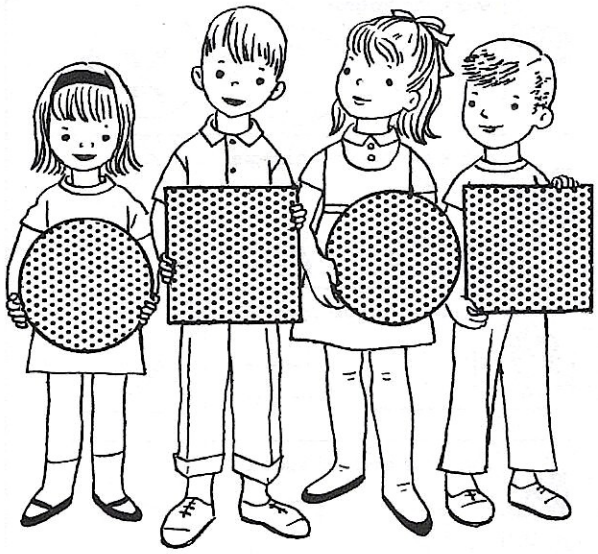
▶ Have the children string short sections of paper drinking-straws. Alternate the straws and cutout paper shapes which have holes punched in the center. Use these for mobiles, or for necklaces and bracelets.



▶ Have the children display different patterns as they line up for marching or for games. Sometimes they may make two lines such as boy-boy-boy and girl-girl-girl pattern—at other times they may form a single line of boy-girl-boy-girl pattern.



Distribute paper circles and squares. Have the children line up in such a way that the shapes which they hold form a pattern.



Patterns

Work Pages K-16 and K-17

Objective

To broaden the children's experience with visual patterns.

Fundamentals

The children have had experience with two types of patterns: those composed of a single shape repeated over and over and those in which two shapes alternate. Variations of the alternating pattern occur when elements of two different colors, of two different sizes, or of two different sizes and shapes are used.

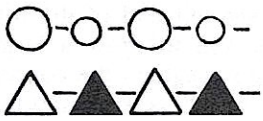
Readiness for Understanding

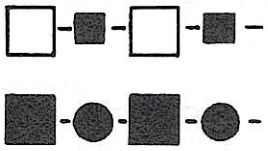
Ability to perceive likenesses and differences.
Ability to recognize the four basic shapes.

Developmental Experiences

MATERIALS	VOCABULARY
beads	extend
bead strings	
colored chalk	

▶ String beads of the same shape but of two different colors to form a pattern of alternating colors. Ask what color comes next. Have the children describe the pattern formed. Repeat with beads of two shapes or two sizes of the same shape. Have the children suggest patterns and take turns stringing the beads.





On the chalkboard, draw a row of alternating shapes. Then have a child repeat the pattern in which different sizes, different colors, or some combination of both are alternated.

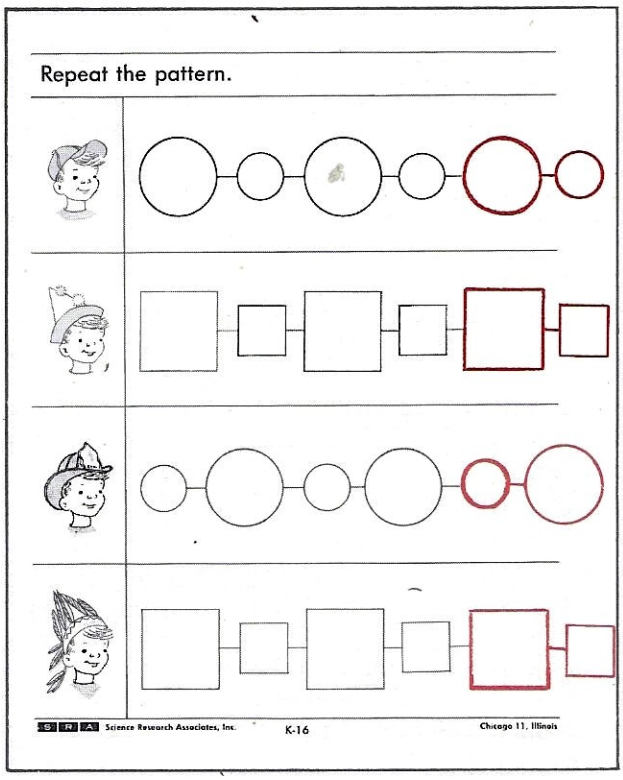
▶ Use work page K-16. Direct the children to examine the shapes in each row and think about the pattern. Have them *extend* each pattern by drawing the shapes that come next, and next.

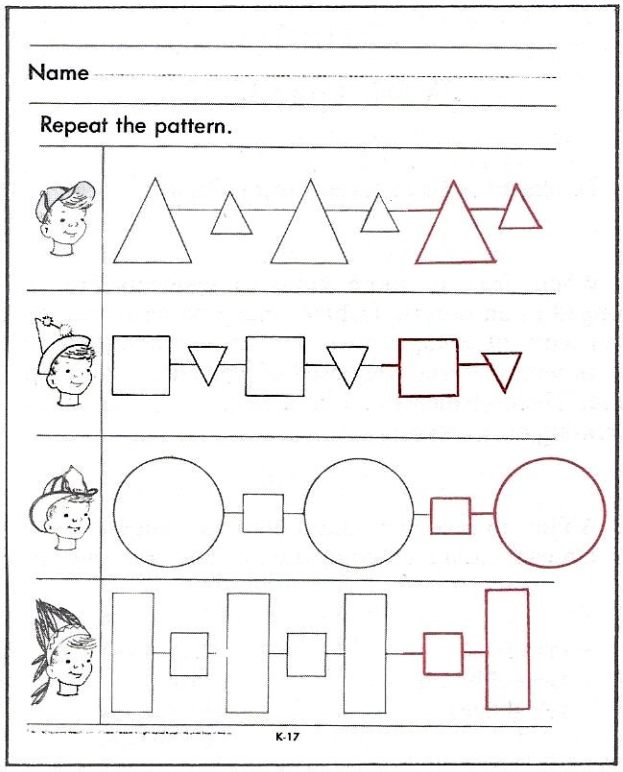
Use work page K-17 in a similar fashion. Have the children describe each pattern in turn, and then draw shapes to extend it.

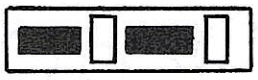
Supplemental Experiences

▶ Encourage the children to create their own patterns by using pegs of two sizes or of two colors. Colored cubes or blocks can also be arranged in rows to form patterns.

▶ Make a variety of pattern cards by first cutting pieces of cardboard or heavy paper into pieces measuring 4″ x 12″ and then pasting a row of cutout shapes on each of them to form a distinct pattern. Leave room at the end of the row to repeat the pattern. Place a variety of extra cutout shapes in a box. Give each child one of the cards. Have him extend his pattern by finding the correct shapes in the box of extras and by placing them in the correct position on his card.

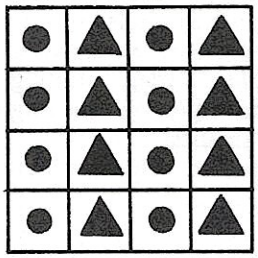


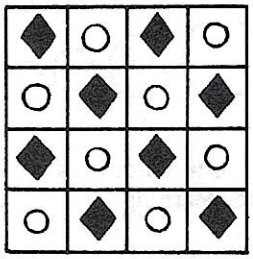




▶ Encourage the children to make their own patterns by drawing or pasting shapes on long strips of paper. Children have great fun using these strips for Indian headbands or for bulletin-board borders.

▶ Help the children fold pieces of paper to form 16 squares. Then have them draw or paste two different pictures alternately in the squares to form two-dimensional patterns.





▶ Making potato-prints provides an opportunity to encourage creation of a variety of patterns. Children are especially pleased when they make their own designs on tissue paper and then use this paper to wrap gifts for parents or friends.

Patterns

Work Page K-18

Objective

To extend skills in pattern recognition.

Fundamentals

When three or more kinds of elements are arranged in an orderly fashion, many patterns emerge. Concepts of comparative size are strengthened by work with patterns composed of elements of different size. These elements can be arranged in order of increasing or decreasing size.

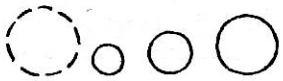
Readiness for Understanding

Ability to recognize the four basic shapes.
Understanding of comparative size relationships.

Developmental Experiences

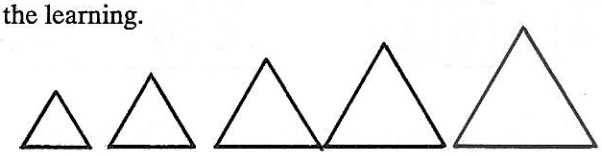
MATERIALS	VOCABULARY
flannel board	order
felt shapes	increasing
	decreasing

▶ Display three felt circles of different sizes. Ask a child to choose the smallest circle and place it on the flannel board. Have a second child choose the next larger circle and place it on the flannel board to the right of the smallest circle. Now hold up the largest circle and ask the children where they think this circle should be placed in the row. Help them decide in which of two positions it looks better. Most children intuitively choose the right-hand placement.

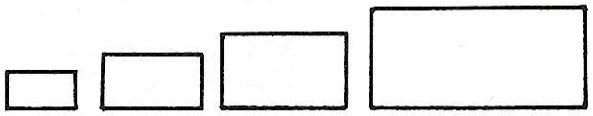


Discuss the *order* of the circles from smallest to largest. Use the term *increasing* to describe this arrangement. Now produce a circle which is larger than any of the others, and have a volunteer place it in the row to extend the pattern. Again discuss the orderly arrangement of the circles. Repeat with a fifth and still larger circle. In the same way lead the children to construct a pattern in which circles of different sizes are arranged in *decreasing* order, starting with the largest and moving to the smallest.

Use cutouts of different shapes to help reinforce the learning.



▶ Draw a row of rectangles of different size on the chalkboard. Have a volunteer describe the arrangement and then extend the pattern by drawing another rectangle. While it would not be incorrect for him to draw a smaller rectangle at the left end of the row, you may wish to encourage him to draw a larger rectangle on the right to help strengthen the concept of left-to-right progression, which is so important for reading readiness.



▶ Use work page K-18. Have the children discuss the pattern in each row. Direct them to draw one more shape to extend each orderly arrangement.

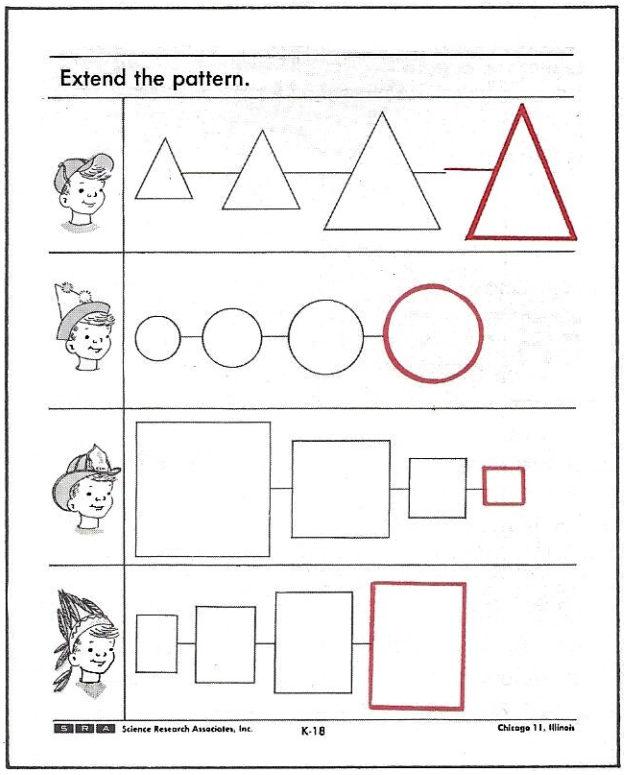
Supplemental Experiences

▶ Have the children work with the sets of cutout shapes and arrange them in order of increasing or decreasing size.

▶ Help the children line up according to height for marching in a parade or for going to the gym. Let the tallest child be the leader one day, the shortest child the next day.

▶ Puzzles which require children to fit graduated circles, squares, and triangles into corresponding holes are available commercially or can be made from plywood or heavy cardboard.

▶ Retell that old favorite "The Three Billy Goats Gruff." When the story is completed, have the children close their eyes and try to visualize these three different sized goats. Dramatize the story. Help the children choose "goats" according to size. Of course, the "troll" will be the largest of all.



The story of "Goldilocks and the Three Bears" also lends itself to dramatization. As a variation use felt cutouts on the flannel board to tell the story and to help the children order the bears, chairs, bowls, and beds according to size.

One-to-One Matching

Work Pages K-19, K-20, K-21, and K-22

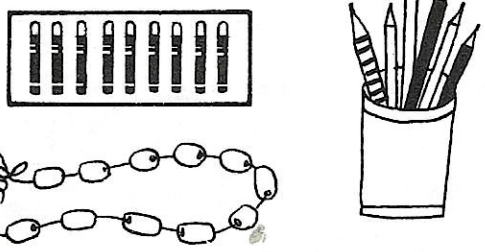
Objectives

To lay a foundation for the concept of number.

To develop a technique for demonstrating that two sets are equivalent.

Fundamentals

Long before a child begins to go to school he has formed some ideas about collections of objects. He quite naturally considers as an entity such things as a bunch of grapes, a string of beads, a sack of oranges, a box of toys, a set of dishes, or a group of children. He decides that certain objects belong together. The kindergarten teacher must reinforce this idea. As the five-year-old hears his teacher repeatedly use the terms "set," "collection," or "group," he becomes increasingly aware of the set concept.



It is not long before the child is ready to compare sets. The teacher then carefully leads him to match one-to-one the objects in two sets which have the same number of elements. She starts the child on the way to abstracting the number property which these two sets have in common. She presents him with a method of discovering whether two sets have the same number of objects, a method of discovering whether two sets are equivalent.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Sets and One-to-One Correspondence.

Readiness for Understanding

Ability to listen carefully and follow directions.

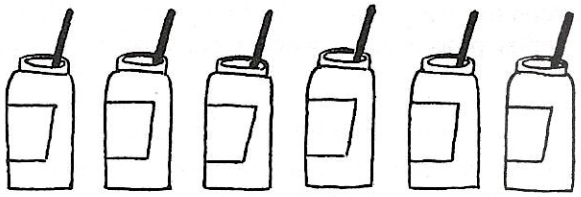
Sufficient eye-hand co-ordination to draw a line between an object in one set and an object in another set.

Developmental Experiences

MATERIALS	VOCABULARY
sets of objects	set
flannel board	one-to-one matching
felt cutouts	as many as
large construction paper	equivalent
crayons	the same number

▶ Have children bring in collections of acorns, chestnuts, leaves, and pine cones. Discuss the idea of *set*.

▶ Place six jars of paint and six brushes on a table. Ask the children if there are enough brushes to have one in each jar. Ask them if they think there are as many brushes as jars of paint. Lead the children to discover that if they put one brush in each jar, they will have *as many as* they need.

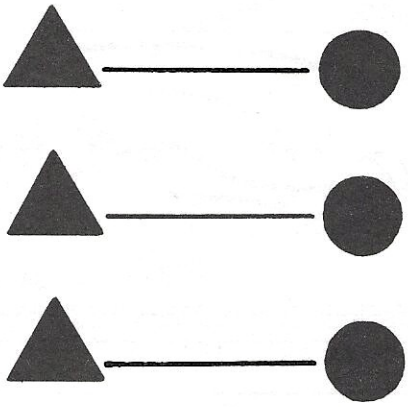


Explain that if it is possible to match the objects of two sets so that for each object in one set there is exactly one object in the other and vice versa, then the sets have *the same number* and are *equivalent*.

Show the children that they found it possible to tell whether the sets had the same number without using number names and without counting. All they needed was the method of *one-to-one matching*.

Reinforce the concept of equivalent sets by having the children match cups and saucers or two kinds of building blocks.

Provide two equivalent sets of cutout felt shapes. Have the children match them one-to-one on the flannel board in order to see if one set has as many objects as the other.



▶ On each of two or three large pieces of construction paper draw two equivalent sets. Place one of the papers on the flannel board. Have a child take a crayon and match the elements in the sets one-to-one by drawing connecting lines between them. Then ask the child whether the two sets are equivalent. Have him explain how he knows this. Use the same procedure with the other pieces of papers.

▶ Use work pages K-19 through K-22 to give the children an opportunity to use the method they now know for discovering whether two sets are equivalent. On these worksheets children are again faced with a fact of vital importance to their understanding of number. They learn that certain pairs of sets are related in a certain way: the elements in the sets are in one-to-one correspondence.

Discuss with the children the elements of the sets on work page K-19. Have them identify the objects in the two sets which they are to match. Have them draw lines with their crayons to find out if there is a balloon for every clown, a ball for every seal. Follow a similar procedure for work pages K-20, K-21, and K-22.

Supplemental Experiences

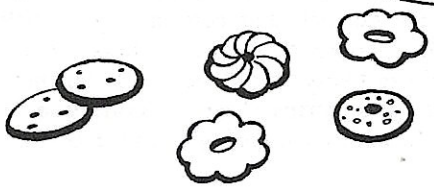
▶ Give the children opportunities throughout the day to practice one-to-one matching while you are passing out papers, crayons, or scissors, or providing chairs, straws, or rugs for each child.

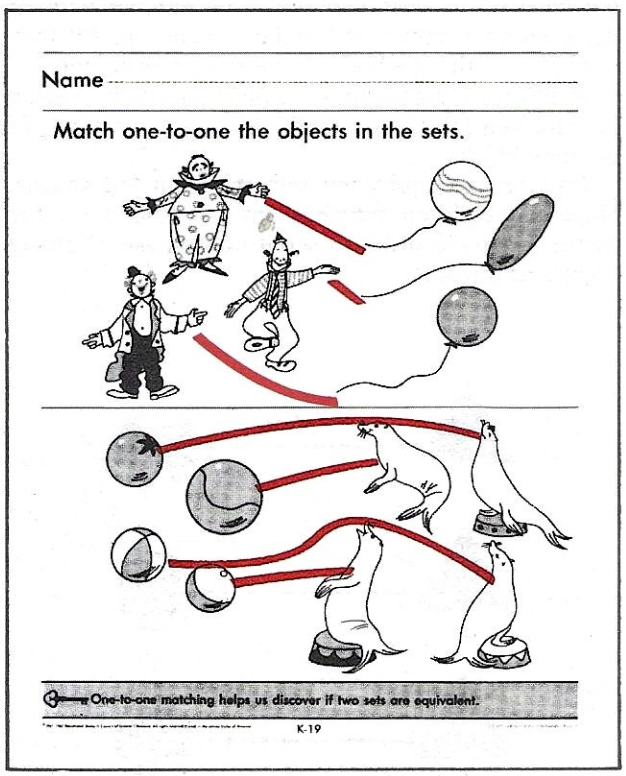
▶ Have a child demonstrate to the class that he has the same number of fingers on each hand. Tell him he must do this without speaking or counting.

▶ Have the children "act out" one-to-one matching. Let one set of boys be birds. Let the same number of girls be trees. As each bird flies to a particular tree, one-to-one correspondence is demonstrated. Vary the activity by asking the children to pretend to be flowers and bees, or engines and engineers. In the same vein, let chairs stand for doghouses and the children for puppies; each puppy must find a doghouse.

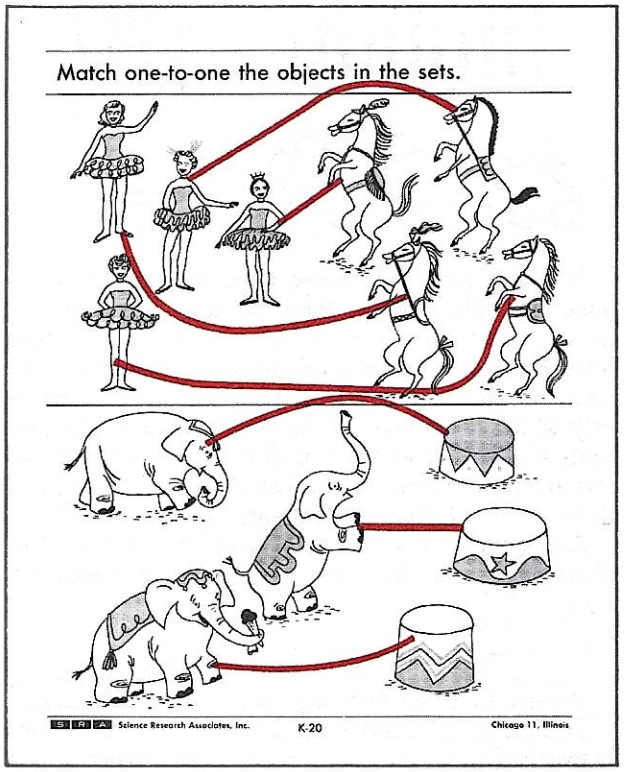
▶ Compose jingles to reinforce understanding of one-to-one matching. Have the children cut out pictures of cakes or cookies from magazines and paste them on pieces of cardboard. Let one child hand out a given number of cookies to the same number of children while the other children recite an appropriate jingle:

Cookies, cookies.
Cookies, I see.
Cookies, cookies.
Match them with me.
One is for Tommy,
One is for Betty,
One is for sister Sue;
One is for Jerry,
One is for Alice,
And here is one for you.





★ More than one correct answer is possible for each problem.



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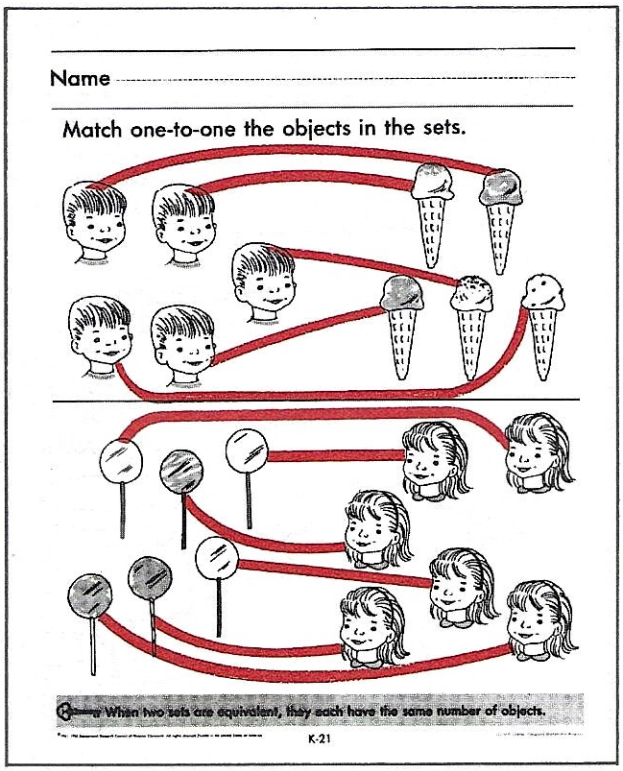

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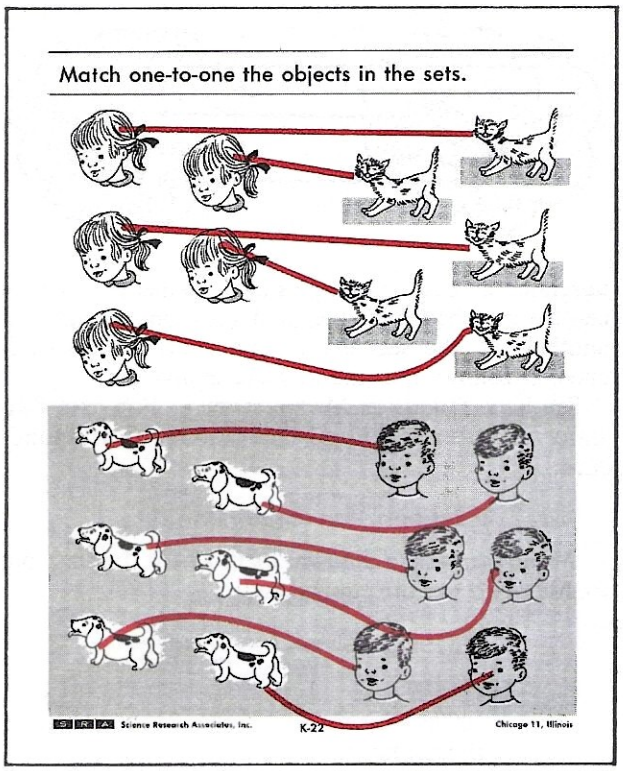


★ More than one correct answer is possible for each problem.

One-to-One Matching

Work Pages K-23, K-24, K-25, and K-26

Objectives

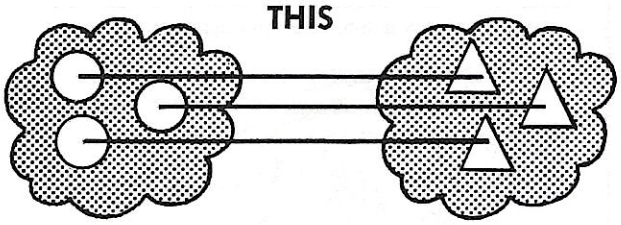
To help children understand that the kind of elements in sets is not important in establishing a one-to-one correspondence.

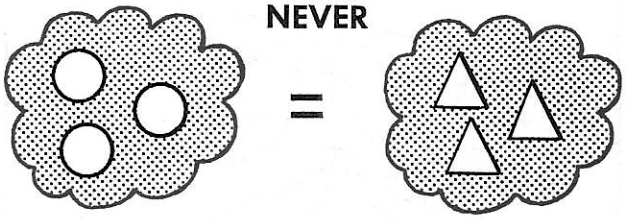
To give additional practice in discovering whether two sets are equivalent.

Fundamentals

For some children, one-to-one matching may seem simple. They may want to count objects in each set or they may recognize at a glance that the two sets contain the same number of objects. It is unlikely, however, that all of the children have learned to abstract the number concept from the sets themselves. This level of understanding comes at different times for different children. Since an understanding of one-to-one correspondence is the first step toward an understanding of number, it is essential that each child have ample opportunity to make this concept an integral part of his thinking.

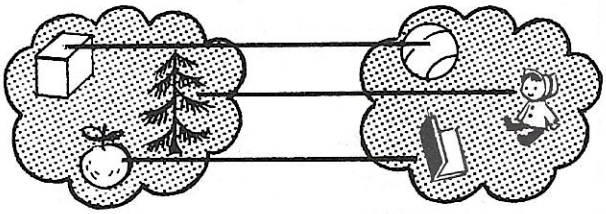
It is important to note that sets which contain the same number of objects are not "equal" sets, and the equality symbol, =, should not be used between the names of these sets. In mathematics the word "equal" means something quite different from the relation of equivalence that exists between sets which contain the same number of objects. At this stage, equivalence between two sets should be indicated by drawing lines between the objects in the two sets.





This will make it clear that the sets have the same number of objects in them or that there are as many objects in one set as in the other.

The children will discover that objects in two sets can be matched one-to-one whether they are the same kinds of objects, related objects, or completely



unrelated objects. As long as each element in one set can be matched with one and only one element of another set, the sets are in one-to-one correspondence. It follows that the sets are equivalent.

See KEY TOPICS IN MATHEMATICS: FOR THE PRIMARY TEACHER: Sets and One-To-One Correspondence.

Readiness for Understanding

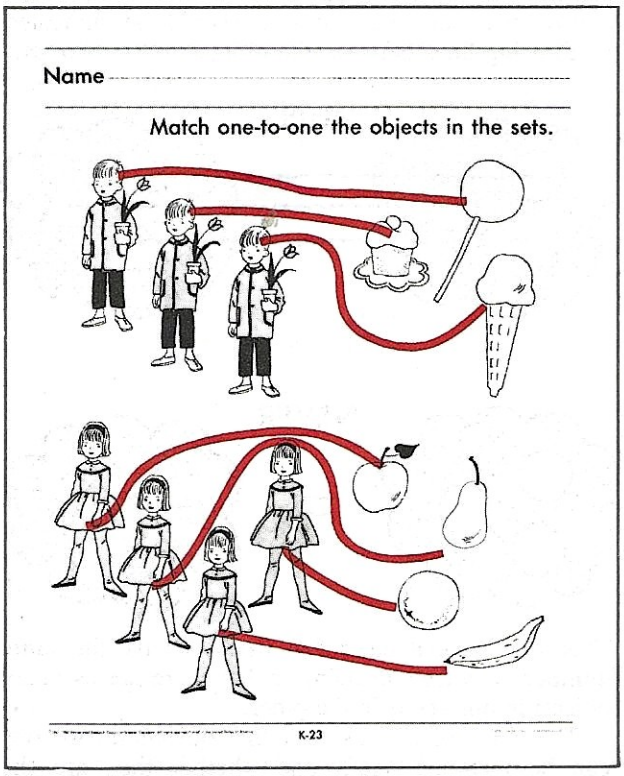
Ability to use a known method for finding out whether two sets are equivalent.

Developmental Experiences

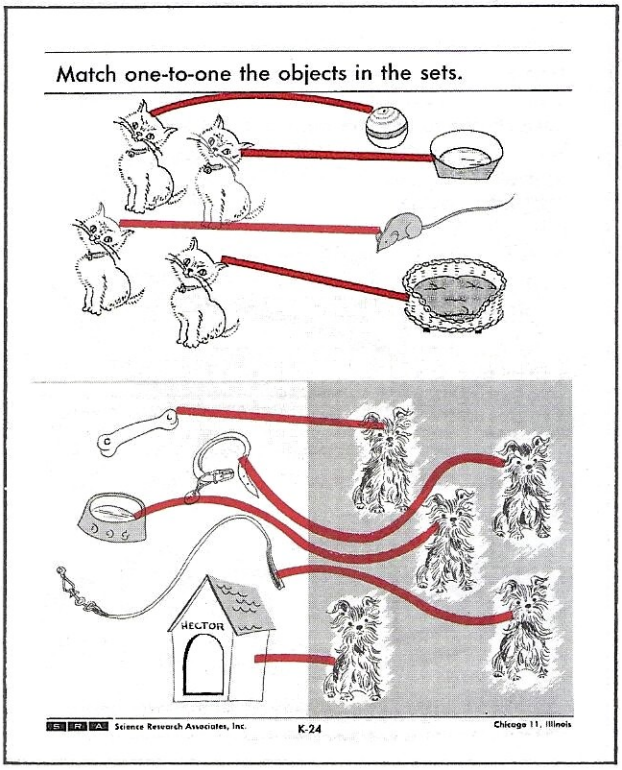
MATERIALS

sets of objects
flannel board
felt cutouts or pictures prepared to adhere to flannel board

▶ Place a set of felt rabbits on the flannel board. Pass out an equivalent set of felt carrots. Have each child place his carrot beside one of the rabbits on the flannel board, and then lead the class to conclude that the sets are equivalent. Have them explain how they know this.



★ More than one correct answer is possible for each problem.



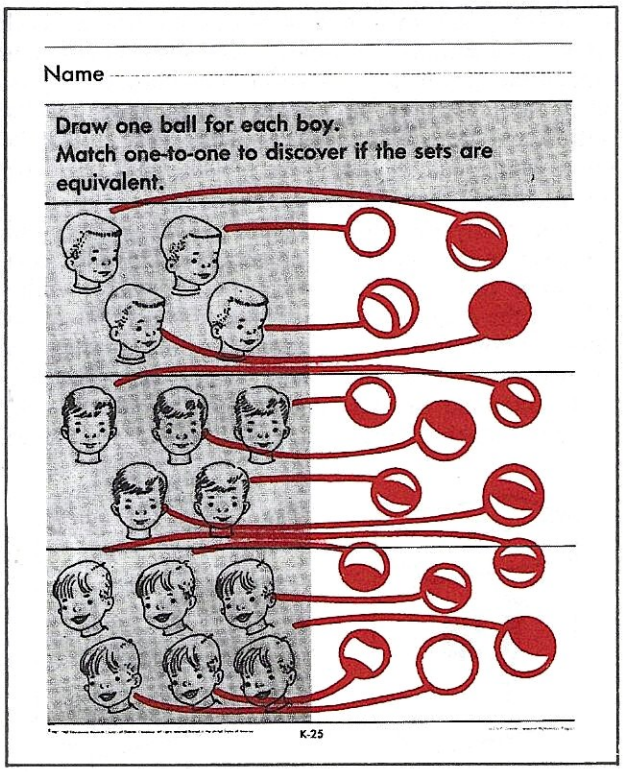
★ More than one correct answer is possible for each problem.

Be sure that the children understand that the kind of objects in the sets does not matter when one tries to find out if the two sets are equivalent. Provide two equivalent sets of mixed pictures or felt cutouts and have them placed side by side on the flannel board. Repeat this activity with different mixed sets, reminding the children on each occasion that it is the number rather than the kind of objects in the sets that is important. The children will soon discover for themselves that the objects in the sets may be matched one-to-one even though the objects matched are unrelated.

▶ Work pages K-23 and K-24 give the children further opportunities to discover, if they have not already done so, that it is the number, not the kind, of objects in a set that matters. Work pages K-25 and K-26 give the children an opportunity to construct sets equivalent to given sets. The pictures the children draw may be completely individual as long as the number of objects in the set is correct.

Discuss work pages K-23 and K-24. Be sure that they have a clear idea about the elements of the sets which they are to match. Explain that they are to draw lines with their crayons to find out if there is one object in the second set for each child in the first set.

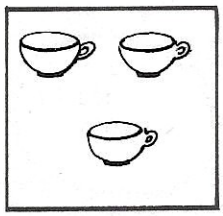
In discussing work pages K-25 and K-26, make certain that the children understand that their sets are to be equivalent to the given sets. Ask them to think about a method they can use to be sure the number of the sets is the same. With this reminder, let them go ahead.

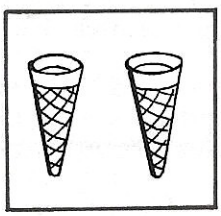


★ More than one correct answer is possible for each problem.

Supplemental Experiences

▶ Make sheets on which appear pictures of several boys, cups, or ice-cream cones. Have the children draw a set which is equivalent to the given set. They may wish to draw a balloon for each boy, a saucer for each cup, or ice cream for each cone.





▶ Direct the children to draw a set on a piece of paper. Have them trade papers and then ask each to draw a set equivalent to the set on the paper he now has.

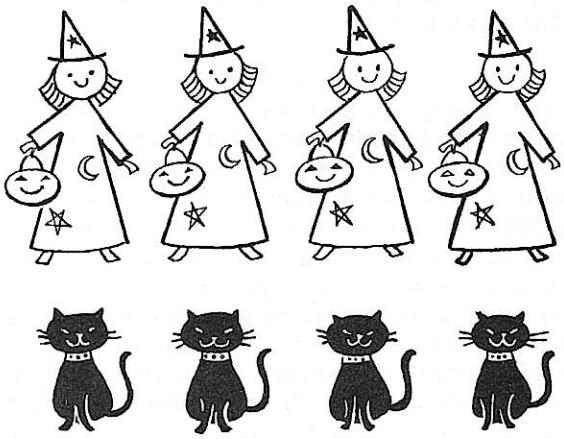
▶ Some children may enjoy cutting pairs of equivalent sets of pictures from magazines. They may find boys and dogs, cowboys and horses, or varied items. Help them make sewing cards by pasting two equivalent sets of pictures on a piece of cardboard. Punch a hole near each picture. Have the children show that the sets are equivalent by sewing a piece of yarn from each member of one set to a member of the other set.

▶ A story involving sets may heighten the children's interest. The theme may revolve around a holiday or a season. The following suggestion may be helpful.

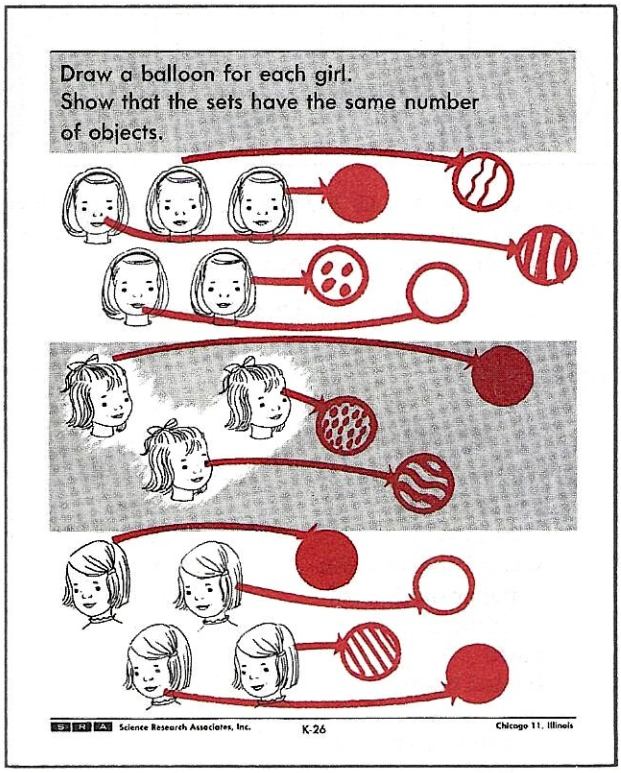
Four witches went out one Halloween. (Place four felt witches on the flannel board.

Each witch took along her jack-o'-lantern to light the way. (Have a child place jack-o'-lantern beside each witch.)

No self-respecting witch would go out without her black cat on Halloween. (Have another child place a cat under each jack-o'-lantern or each witch.)



Continue the story with an encounter between the witches and four ghosts. A creative teacher will have no difficulty capturing interest as the story unfolds.


Draw a balloon for each girl.
Show that the sets have the same number of objects.
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K-26
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★ More than one correct answer is possible for each problem.

Numbers and Numerals
One—1
Work Page K-27

Objectives

To teach the meaning of the number one.

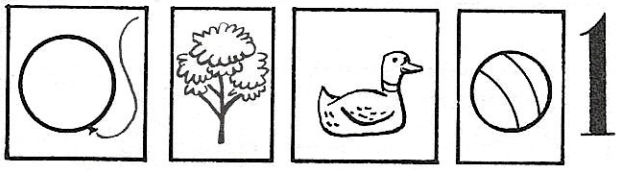
To provide practice in recognizing sets containing one object.

To help children understand that a number can be represented by a specific numeral.

To help children recognize the numeral 1 and to relate it to sets of one.

Fundamentals

In the early stages of developing the number concept, the young child thinks of numbers only in relation to sets of concrete objects. Before long he learns a name for a property which is common to certain sets. He associates a tag or label with a particular set. He attaches this same label to any set that is in one-to-one correspondence with the particular set he agreed to call by a given name. He learns to abstract this property from the sets themselves and to think only of the number. In the case of sets containing a single object, the name given to the property is *one*. Eventually the child is introduced to the written mark or symbol created to represent a particular number. He becomes aware that numerals are not numbers, but names for numbers. At first the child thinks in terms of one balloon, one tree, one duck, or one ball. Gradually he learns to think of just *one*.



See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Numbers and Numerals; Sets and One-To-One Correspondence.

Readiness for Understanding

Awareness of a common property in pairs of equivalent sets.

Developmental Experiences

MATERIALS

- sets of concrete objects
- several construction-paper outlines of numeral 1
- paste
- flannel board
- pins
- pictures of various sets
- felt numeral 1

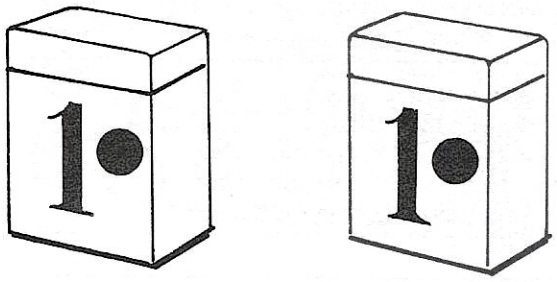
VOCABULARY

- number
- numeral
- name
- one

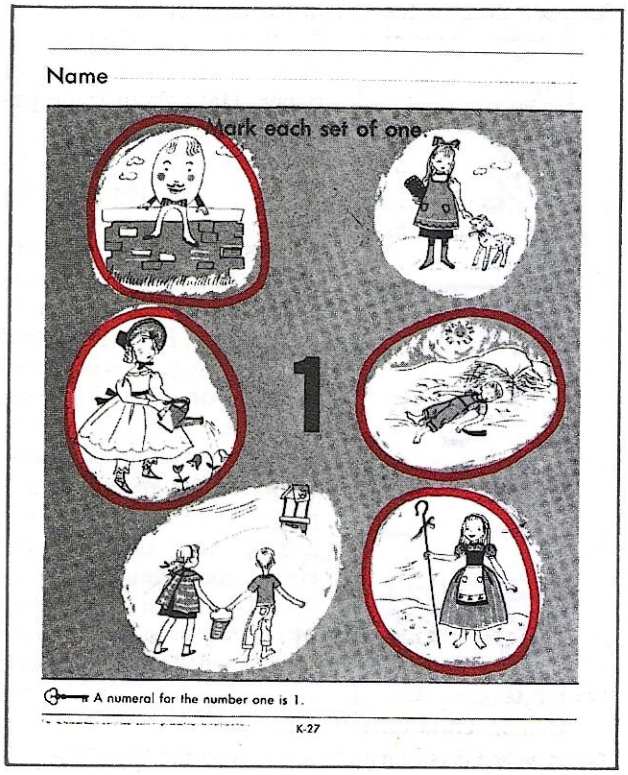
▶ Display several boxes or plastic containers, each of which contains one object. Ask some children to match the sets in pairs, showing that they are equivalent. Discuss the time involved in matching the sets. Lead the children to conclude that it will be more convenient if they have a *name* that tells how many objects are in each set.

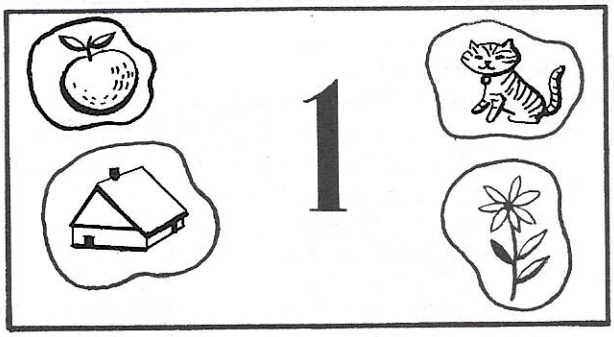
Ask if anyone knows a name which can be used to describe the number of objects in each of the sets. As some child gives the word *one,* write the symbol "1" on the chalkboard. Explain that a person can let others know that he is thinking of the *number* one by using the word "one" or by writing the *numeral* 1.

Re-examine the sets and assign the name "one" to each; attach a paper numeral 1 to each container.



▶ Place a large felt numeral 1 and a set of one on the flannel board. Have pictures of various sets turned face down in a large box. Ask a child to reach in the box and pick out a picture. If the picture belongs in the "one family," have the child pin it on the flannel board. If it does not belong to that family, put the picture aside. Repeat the activity until several children have had turns.



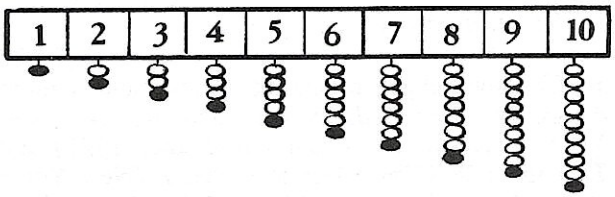


▶ Use work page K-27 after the group activity relating to the numeral concept. Have the children identify the large numeral 1 in the center of the page. Remind them that a numeral for the number one is 1. Discuss each set on the page, recalling the nursery rhyme which it illustrates. Identify the elements in each set. Show the children how to place a mark on each set which contains one and only one object. Work with the children as they mark the Humpty Dumpty set and decide that Mary and her little lamb should not be marked. Encourage them to complete the page independently. Give help only to those who need it.

Supplemental Experiences

▶ Discuss sets of one in the classroom: one clock, one teacher's desk, one piano. Expand the discussion to include the things that come only in sets of one: each child has only one nose, one head, one mouth.

▶ Have a child string one bead and put it on a bulletin board with the numeral 1 above it. On succeeding days extend this display.



▶ Sing songs such as "One Day One Foot Kept Moving" from *Music for Early Childhood,* (Morristown, N.J.: Silver Burdett Co., 1952).

Numbers and Numerals

Two—2

Work Page K-28

Objectives

To teach the meaning of the number two.

To provide practice in recognizing sets containing two objects.

To help children recognize the numeral 2 and to relate it to sets of two.

To help children become aware of the natural order of the whole numbers.

Fundamentals

The child has his first glimpse of the natural order of the whole numbers, when he relates a set of one to a set of two. The "one-more" pattern that is involved in building the natural number sequence becomes more evident to the child as comparisons are made between various sets whose numbers are greater than one and two.

If one tries to pair the element in a set of one with the elements in a set of two, for example, one element still remains unpaired. The same holds true if one tries to pair the elements in a set of two with the elements in a set of three.

An important discovery has been made. When certain sets are arranged in a particular order, each successive set has one more element than the previous set had. In other words, each set in this ordered sequence is equivalent to the set formed by joining one more element to the previous set.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Numbers and Numerals; Sets and One-To-One Correspondence; Order—Relations—Operations.

Readiness for Understanding

Understanding of the property common to sets of one.

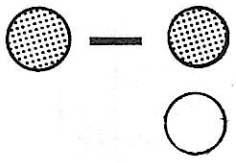
Ability to associate the numeral 1 with sets of one.

Developmental Experiences

MATERIALS	VOCABULARY
flannel board	one more
felt cutouts	two
large felt numerals 1 and 2	

▶ Place a red disk on the flannel board and have the children tell how many objects they see. Put another red disk on the board, at some distance from the first, and ask the children to tell how many they see in this instance. Then place a green disk under the second red disk and guide the children to an awareness that this new set contains one and *one more*.

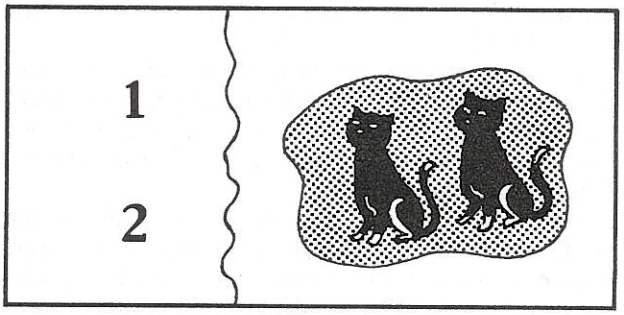
Ask if anyone knows a word that can be used to label the new set, a word that tells how many are in the second set. Lead the children to understand that the number of this set is *two*.



Have the children try to match the elements in another set of one and in another set of two. Using different elements in the sets each time, repeat this activity. Emphasize always that one of the sets has one more object than the other set has. Encourage the children to use the names "one" and "two" when working with the sets.

▶ Put a large numeral 2 on the flannel board. From an assorted collection of felt cutouts, have several children select individual sets of two and place them around the numeral.

Place the felt numerals 1 and 2 on the left side of the flannel board. Present a set of one on the board. Have a child choose the numeral that names the number of this set and place it next to the set. Continue the activity, alternating sets of one and two.

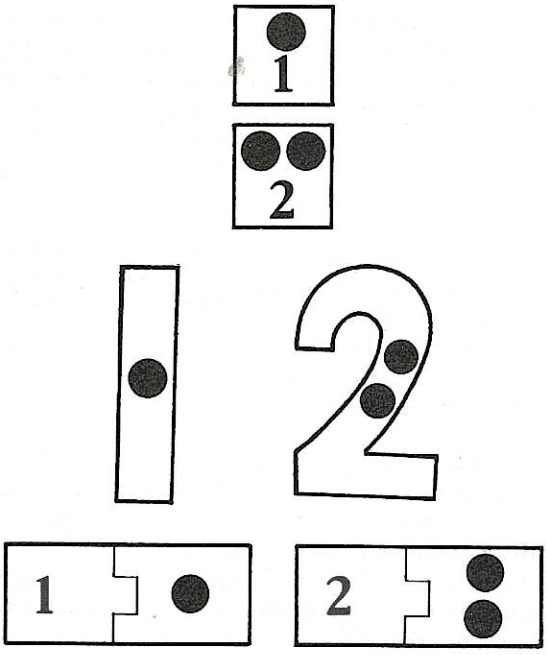


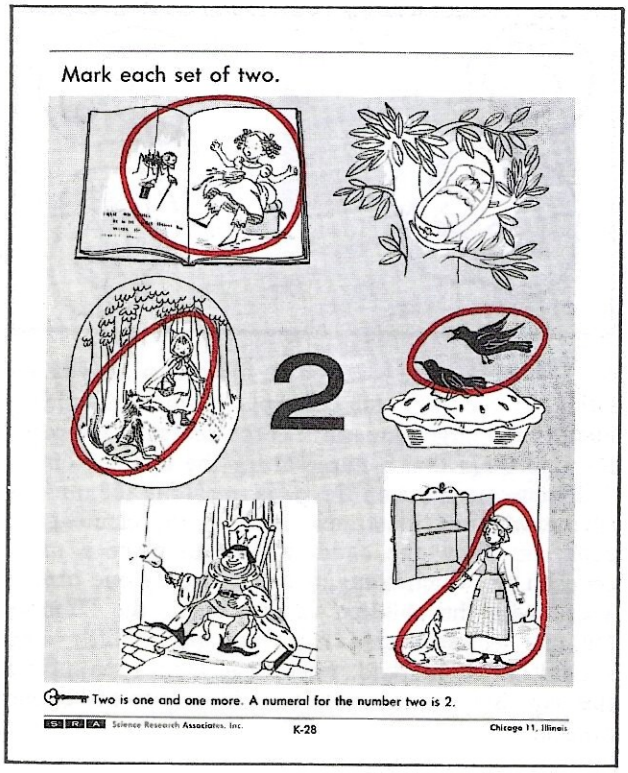
▶ Have the children find sets of two objects about the room. Point out a set of one or two objects and ask the children to tell the number of the set.

▶ Present work page K-28. Ask someone to identify the large numeral 2 in the center of the page. In turn, discuss each set on the page; identify the elements in each set. Have some child tell what "two" means—that it means one and one more. Direct the children to place a mark on each set which contains two and only two objects. Work with the group as they decide whether or not to mark Little Miss Muffet and the spider and Rock-a-Bye Baby. Encourage the children to complete the remainder of the page independently. Give help only when needed.

Supplemental Experiences

▶ Make or buy simple puzzles which require the children to match sets with numerals.




Mark each set of two.
2
Two is one and one more. A numeral for the number two is 2.
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K-28
Chicago 11, Illinois

▶ Begin a large Number Book. On the first few pages write the numeral 1. On the next three or four pages write the numeral 2. Ask each child to bring in a picture of a set of one object or a picture of a set of two objects. Have the children paste the pictures on the appropriate pages. Ask each why he thinks his picture belongs on a particular page.

▶ Enact finger plays.

▶ Children delight in hearing stories about familiar things. *The Two Reds* by WILL and NICOLAS (New York: Harcourt, Brace and World, Inc., 1950) and *Two for a Walk* by NATHAN KRAVETZ (New York: Henry Z. Walck, Inc., 1954), and *One Is Good but Two Are Better* by LOUIS SLOBODKIN (New York: Vanguard Press, Inc., 1956) are possibilities for story time.

▶ Plan a bulletin board on which may be displayed items that come in pairs, or twos, such as mittens, earmuffs, and shoes.

▶ Children will enjoy learning poems about sets of two. Use "The Twins" by Elizabeth Madox Roberts (in *Away We Go!*, compiled by Catherine S. McEwen; New York: Thomas Y. Crowell Co., 1956), "Us Two" by A. A. Milne (in *The World of Christopher Robin*, A. A. Milne; New York: E. P. Dutton & Co., 1958), or "Twos" by John Drinkwater (in *Anthology of Children's Literature*, E. Johnson and others; Boston: Houghton Mifflin Co., 1940). Help them think of the many nursery rhymes which contain two characters such as "Jack and Jill," and "Mary Had a Little Lamb."

Numbers and Numerals
Three—3

Work Pages K-29 and K-30

Objectives

To teach the meaning of number three.

To provide practice in recognizing sets containing three objects.

To help the children recognize the numeral 3 and relate it to sets of three.

To re-emphasize the difference between number and numeral.

Fundamentals

Introducing the children to the abstracting of number poses two distinct problems. First, the children must understand the concept. Second, they must learn to distinguish between the symbol for the concept and the concept itself.

Often it is not clear whether a person means the number itself or the numeral which represents this number. Many times it is difficult to make this distinction without being wordy.

In the early stages of development it is wise to keep the language as simple as possible when communicating with the children. It is equally important to speak as precisely as possible about the ideas.

The word "numeral" should be used only when there is reference to the mark or written symbol. In all other cases the word "number" should be used.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Sets and One-To-One Correspondence; Numbers and Numerals; Order—Relations—Operations.

Readiness for Understanding

Ability to recognize sets of one and sets of two.

Ability to associate the appropriate numeral with sets of one and sets of two.

Developmental Experiences

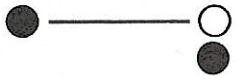
MATERIALS

flannel board
felt cutouts
picture cards
large felt numerals
1, 2, and 3
2″ x 8″ cardboard
markers

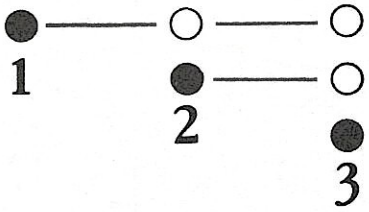
VOCABULARY

three

▶ As a review exercise, place a set of one and a set of two side by side on the flannel board. Ask the children to explain what "two" means. Guide them to keep uppermost in their thinking the idea of "one-more."



▶ Place a set of three next to the set of two. Have two elements in the set of one color and the third element of a different color so that the "two-and-one-more" pattern is obvious. Ask the children to tell what they observe about the set of three in relation to the set of two. Bring out the fact that the set of *three* contains two and one more, just as the set of two contains one and one more. Ask one child to place the appropriate felt numerals under the sets of one and two.

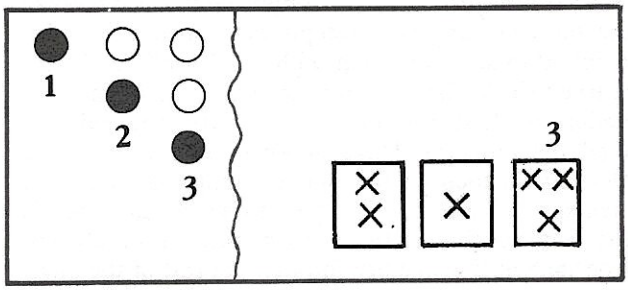


Introduce the numeral 3 and have it placed under the appropriate set. Leave the sample sets on the flannel board, and distribute picture cards on which appear sets of one, two, or three. Have various children come to the front of the room and show their cards. Ask each to tell the number of the set on his card. Have him point to the set on the flannel board that has the same number of elements in it and that is in one-to-one correspondence with the set on his card.

▶ Vary the activity with the picture cards. Ask one child to come forward and show his card to the class. Any child who has a card on which appears an equivalent set must stand next to the first child and show his card. Ask the class to tell why the two cards belong together.

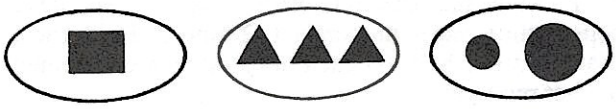
▶ Throughout the preceding activities and the one to follow be sure that sample sets are in view. The one-more bead display, begun when number one was introduced, will serve the purpose. Whenever a child is in doubt about the number of his set or the numeral which is associated with a particular set, refer him to the sample set.

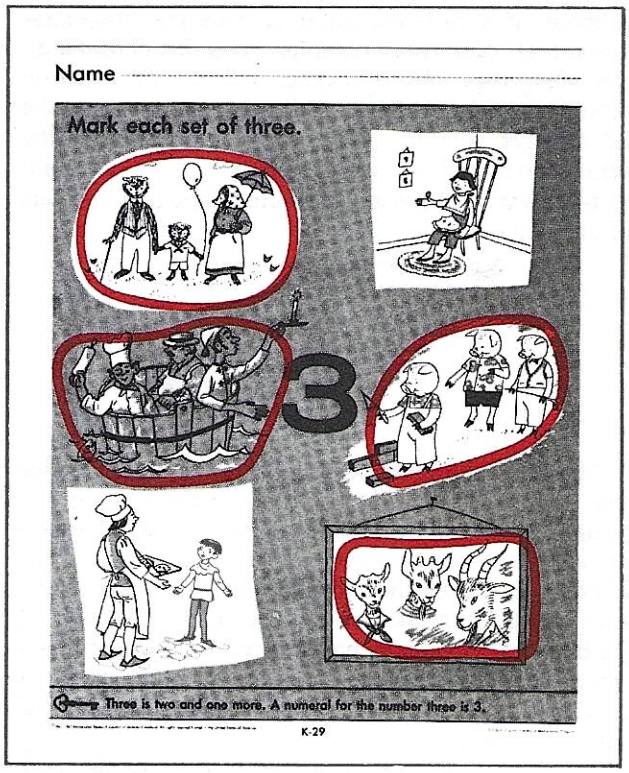
Place a numeral 1, 2, or 3 on the flannel board. Pin picture cards showing sets of one, two, and three along the lower edge of the board. Have a child place the numeral over the appropriate card.



▶ Draw a set of one, a set of two, and a set of three on the chalkboard. Write the numeral 3 and ask a child to put a mark on the set which contains that many pictured objects.

Repeat this procedure with the other sets and with the numerals 1 and 2.





▶ Work page K-29 gives the children further opportunities to identify sets of three. Ask the children to point to the numeral which appears on this page. Have a child say the name of the number which the numeral represents. Ask another child to tell what "three" is: "the number that is one more than two." Discuss each set on the page; identify the members of each set. Tell the children to place a mark on each set that contains three, and only three, objects. Guide the group carefully as they decide if they should mark the set of three bears and the Little Jack Horner set. Encourage independent work on the rest of the page.

▶ Work page K-30 offers opportunity for review of the number-numeral concepts developed up to this point. Provide each child with a 2″ x 8″ cardboard marker. Tell the children to place their markers under the first row of pictures. Ask one child to read the numeral. Have another child identify the elements in each set without revealing the number of elements. Direct the children to mark each set in the row which has the correct number of objects. Continue in this manner through the rest of the page.

Supplemental Experiences

▶ Arrange a table display of collections of such objects as toy airplanes, toy trains, toy boats, and toy cars. Label each set of toys with numeral 1, 2, or 3.

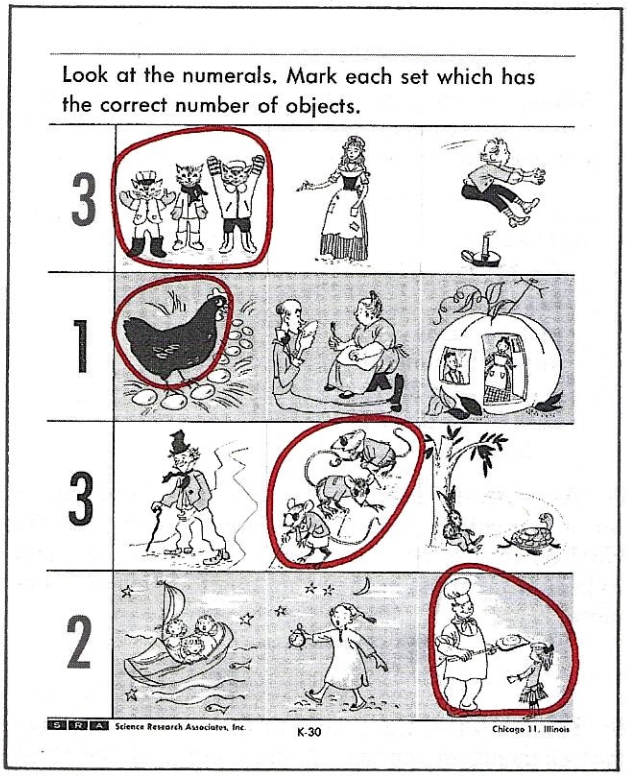
▶ Provide the children with crayons and large construction paper numerals 1, 2, and 3. Have them draw as many balls on each numeral as are indicated by that numeral.

▶ Blindfold one child. Have him stand before the flannel board. Place a large sandpaper numeral 3 on the board. Gently guide the child's finger around the shape of the numeral. Ask him to tell what numeral is on the board. Continue the activity using numerals 1 and 2.

▶ Teach children the verse, "I See Three." Have them recite it as related objects are placed on the flannel board.

*I SEE THREE**

I see three—one, two, three,
Three little bunnies
Reading the funnies.
I see three—one, two, three,
Three little kittens
All wearing mittens.
I see three—one, two, three,
Three little frogs
Sitting on logs.
I see three—one, two, three,
Three little bears
Climbing upstairs.
I see three—one, two, three,
Three little ducks
Riding on trucks.



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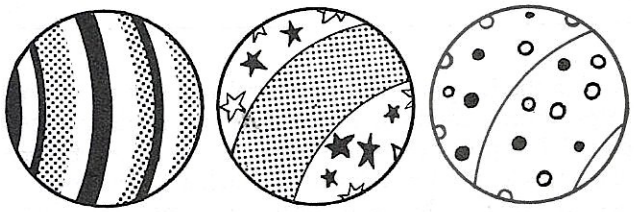
▶ Read such old favorites as "The Three Billy Goats Gruff," "The Three Bears," and "The Three Little Pigs." A contemporary approach to the ideas of two and three is found in *Two Little Birds and Three* by JULIET KEPES (Boston: Houghton Mifflin Co., 1960).

▶ Have children sing "Three Red Apples," from *Another Singing Time,* SATIS N. COLEMAN and ALICE G. THORN, (New York: John Day Co., 1937).

▶ Play a game, using three balls. Relate the action to the words of the verse "Three Balls."

*THREE BALLS**

Here is a big, round, bouncy ball.
I bounce it, 1, 2, 3.
Here is a ball for throwing.
I can catch it,
Watch and see.
Here is a ball for rolling;
Please roll it back to me.
Bouncing;
Throwing;
Rolling balls;
Let's count them: 1, 2, 3!



Numbers and Numerals

Four—4

Work Pages K-31 and K-32

Objectives

To teach the meaning of the number four.

To provide practice in recognizing sets containing four objects.

To help children recognize the numeral 4 and to relate it to sets of four.

Fundamentals

Development of the idea of the unending sequence of numbers continues. Every new natural number in the sequence after 1 is derived from its predecessor by adding one more.

It is difficult for a young child to conceive of numbers marching on without end. His world is limited; his experiences prohibit anything but the vaguest picture of an endless stream of numbers. Nevertheless, the kindergarten teacher must accept the responsibility for playing a vital role in stirring the five-year-old's imagination with the idea of one-more. She is in a key position to plant the seed for future learning and to plant it well.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Sets and One-To-One Correspondence; Numbers and Numerals; Order—Relations—Operations.

Readiness for Understanding

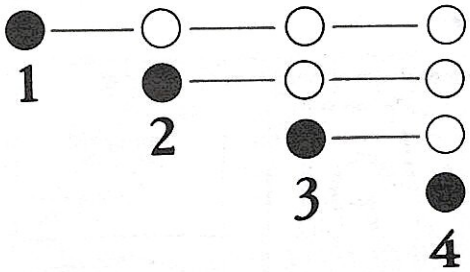
Ability to recognize sets of one, sets of two, and sets of three.

Ability to associate the appropriate numeral with sets of one, sets of two, and sets of three.

Developmental Experiences

MATERIALS	VOCABULARY
felt numerals 1, 2, 3, and 4	four
large cards bearing sets of one, two, three, and four	
flannel board, sets of felt counters	
large construction paper and crayons	
2″ x 8″ markers	

▶ Build upon known ideas. Place a set of one and a set of two side by side on the flannel board. Make certain that the "one-more" pattern stands out. Say, "Here is a set of one. Next to it is a set of one and one more." Ask, "What do we call this set of one and one more?" Build the next set of three and say, "Now we have a set of two and one more. What do we call this set?" Place another set of three beside the last set appearing on the flannel board, and say, "How can we finish building the set that comes after the set of three?" The children who have reached a more mature level of understanding will know that the next set, the set of *four,* will contain three and one more.



Introduce the numeral 4 and have some child place it under the set of four. Ask other children to place the numerals 1, 2, and 3 with the appropriate sets.

Leave the sample sets in place, remove the numerals 1, 2, 3, and 4, and replace them in a scrambled order on the flannel board. Ask a child to come to the flannel board and point to the numeral that is the label for the set of one and one more. Ask another child to pick out the numeral for the set that contains two and one more. Continue until several children have had turns.

Vary the activity by having different children come to the flannel board to build sets of three and one more, two and one more, or one and one more.

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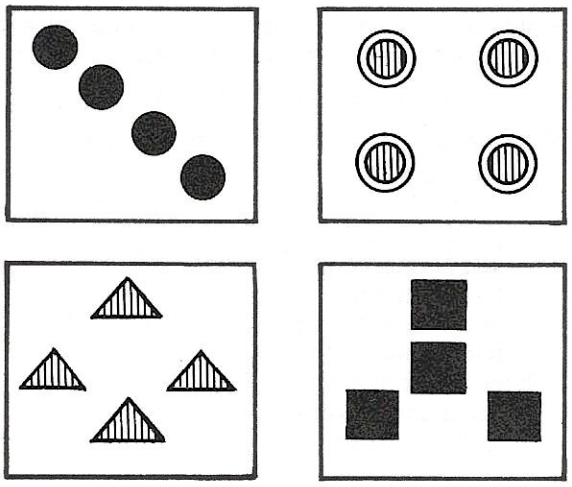
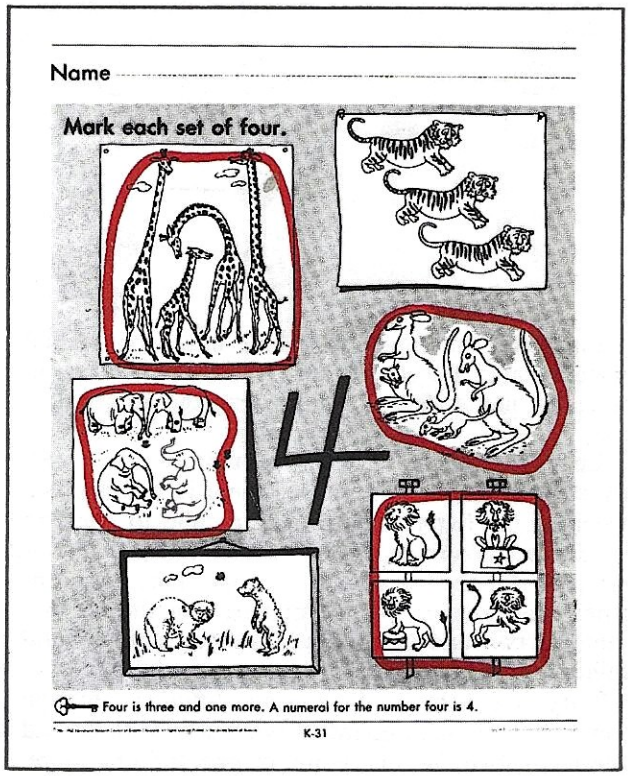
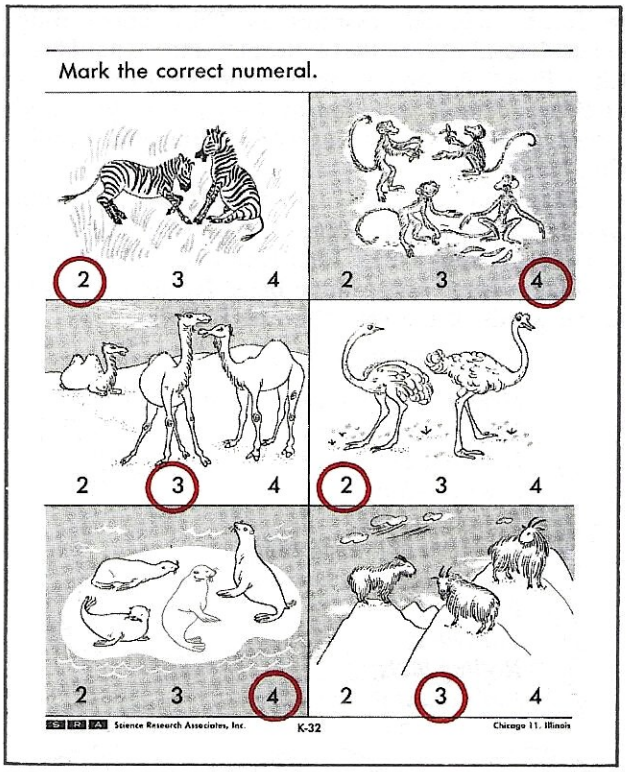
▶ Construct a group of large cards bearing pictures of sets of one, two, three, and four arranged in various patterns. Hold up one of the cards. Ask a child to tell you, without counting, how many are in the set. Continue the activity. Build up speed in recognition of the sets by exposing the cards for shorter and shorter periods of time.



▶ Write the numeral 4 on a large piece of construction paper. Fasten the paper to a firm surface. Have a child take a crayon and draw a set of four beside the numeral 4. Ask two or three other children to do the same thing. Continue in the same way with different numerals.

▶ Use work page K-31 to reinforce recognition of sets of four. After the children have identified the large numeral 4 in the center of the page, have them take their fingers and trace around the symbol.



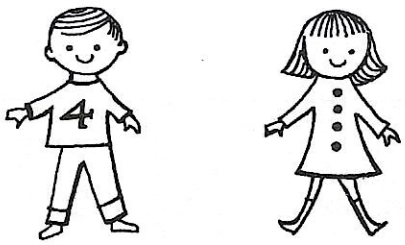


A kinesthetic approach to numeral recognition often helps slower children. Proceed in the manner suggested for previous worksheets of this type. Have children identify the elements in each set. Ask someone to explain what four means. Re-emphasize that four is the number that is one more than three. Work with the group as they think about the number of the set of giraffes and of the set of tigers. Direct the children to mark each set of four on this page.

▶ Work page K-32 will help you to evaluate the children's recognition of sets of two, three, and four and the related numerals. Since the format of work page K-32 will be new to the children, take time to orient them to it. Present samples of the format on the chalkboard. Draw a set and under that set draw three different numerals. Ask a child to mark the numeral that belongs with the set. Repeat this activity until you are certain that the children understand this new procedure. Ask the children to place their markers under the first row of pictures on work page K-32. Tell them to look at the set of zebras, and to think how many are in this set. When they have decided, direct them to mark the numeral that belongs with this set. Proceed in this manner with the other sets on this page. Work with the children, step by step.

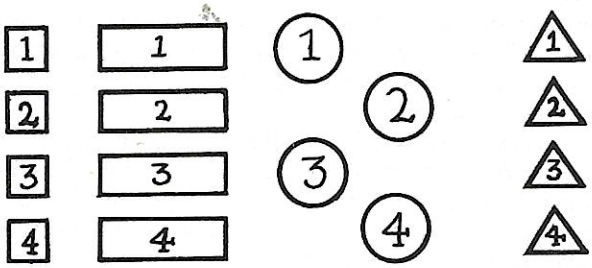
Supplemental Experiences

▶ Cut out several boy paper dolls and girl paper dolls, and adapt them to adhere to the flannel board. On each boy doll write a numeral from 1 through 4. On each girl doll draw a set of from one through four.



Place the boy dolls in a random arrangement on the left half of the board. Place the girl dolls in a random arrangement on the right half of the board. Have a boy choose one of the boy dolls and place it in the center of the board. Ask the children to note the numeral on the doll. Ask a girl to choose the girl doll with the appropriate set drawn on it, and to place it beside the boy doll. Continue in this way with the other paper dolls.

▶ Write the numerals from 1 through 4 on four squares, four triangles, four circles, and four rectangles. Have the children sit in a large circle on the floor. In the center of the circle place the various shapes with numerals written on them. Call upon some child to bounce a ball on the square with numeral 4 on it. Have another child bounce the ball on the rectangle with numeral 4 on it. Continue the game with the circle and triangle, and proceed with the other numerals.



▶ Provide the children with large paper divided into four boxes. Write a numeral in the corner of each box. Direct the children to draw or paste the appropriate number of pictures in each box.

▶ Teach the children verses about different sets.

FOUR LITTLE MONKEYS

Two little monkeys sitting in a tree,
Were joined by another and that made three.
Three little monkeys in the tree did play,
They chattered and chattered in a happy way.
Three little monkeys wishing for one more,
Another came to join them and that made four.
Monkeys, monkeys, how many do I see?
Four little monkeys sitting in a tree.

A. A.MILNE'S "The Four Friends" from *The World of Christopher Robin* (New York: E. P. Dutton & Co., 1958) provides another experience with four.

▶ Read stories about the number four, such as *The Four Little Foxes* by MIRIAM SCHLEIN (New York: William R. Scott, Inc., 1953) or *The Four Riders* by CHARLOTTE KRUM (Chicago: Follet Publishing Co., 1953).

Numbers and Numerals
Five—5

Work Pages K-33 and K-34

Objectives

To teach the meaning of the number five.

To provide practice in recognizing sets containing five objects.

To help children recognize the numeral 5 and to relate it to sets of five.

To teach one-by-one counting as a way of identifying the number of a set.

Fundamentals

The young child most easily learns to abstract the concept of cardinal number by working with sets of one, two, three, and four. While a child could use one-by-one counting to reach his destination, it is instantaneous recognition which presents the clearest picture of the meaning of cardinal number.

When working with sets of less than five, the skillful teacher encourages the child to look at the set and to think of the number. She discourages counting of sets of this size, except in those cases in which a particular child does not show a sufficient level of maturity to benefit from this approach.

As the child studies sets of five, it is quite likely that he will find it easier to identify the number of the set by counting one-by-one. A more mature child may recognize a subset within the set and begin his counting with the number of the subset. He may, for example, recognize a subset of three objects immediately and count "3, 4, 5," instead of "1, 2, 3, 4, 5."

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Sets and One-To-One Correspondence; Numbers and Numerals; Order—Relations—Operations.

Readiness for Understanding

Ability to recognize sets whose number is less than five.

Ability to associate the appropriate numeral with any set whose number is less than five.

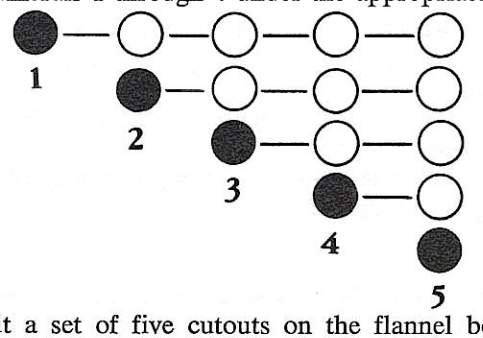
Developmental Experiences

MATERIALS	VOCABULARY
flannel board	count
sets of felt cutout counters	five
felt numerals 1 through 5	
2″ x 8″ markers	

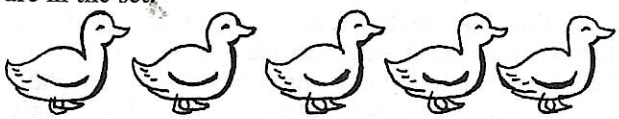
▶ In order to stress the meaning of *five* as the number which is one more than four, begin the development of the concept with the "one-more" pattern. On the flannel board arrange in order sets whose number is less than five. Have the children

describe each set in terms of the "one-more" pattern: "two is one and one more," "three is two and one more," "four is three and one more."

Place a set of five next to the set of four. Build it as a set of four and one more. Introduce the numeral 5. Have a child place it under the set of five on the flannel board. Direct other children to place the numerals 1 through 4 under the appropriate sets.



▶ Put a set of five cutouts on the flannel board. Demonstrate *counting* as a method of determining how many are in the set. Match, one-to-one, each object in this set with a set of numerals for the counting numbers 1, 2, 3, 4, and 5. Point to each object in the set as the count proceeds. Direct the children to watch carefully and listen closely during the procedure. Guide children to an awareness that the last number named in the counting process is the cardinal number of the set, that it tells us how many are in the set.



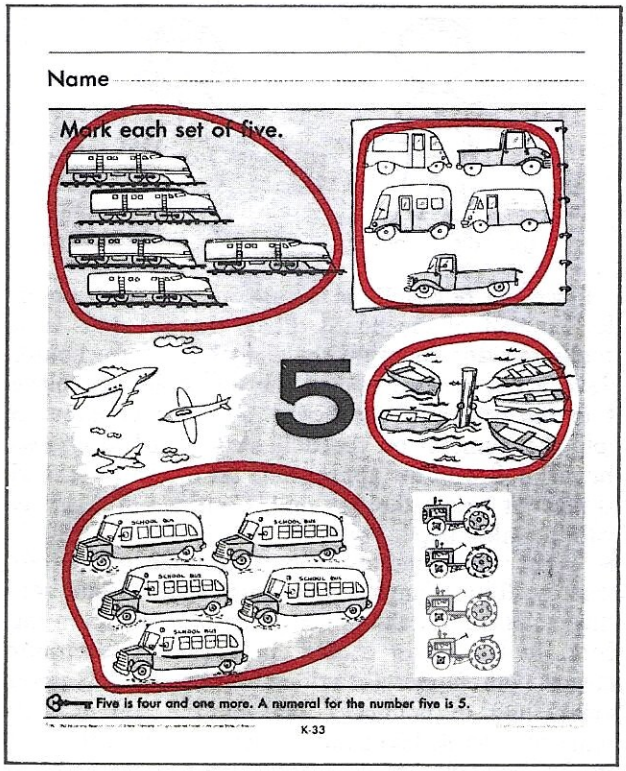
1 2 3 4 5

▶ Tell the children to listen as you clap your hands. Say that they must be ready to tell how many claps they hear. Start with three claps. Go on to five claps, four claps, and two claps. Have the children take turns clapping and choosing another child to give the number.

▶ Distribute the felt numerals 1 through 5 to five children in the group. Build a set of four on the flannel board. Tell the children that the one who has the numeral that belongs with this set must come forward and place it next to the set on the flannel board. Now remove the set from the board and have the child give the numeral 4 to someone else in the group who does not have a numeral. Continue the activity by building many different sets and having children match their numerals to the sets.

▶ Place a large square on the chalkboard. Have the children draw several sets of four or five around the square. Write the numeral 5 in the square. Ask a child to come to the chalkboard and mark a set that belongs with the numeral he sees.

▶ Use work page K-33 to provide practice in recognizing sets of five. Ask the children to tell what numeral they see in the middle of the page. Tell the children to use their finger to trace around the numeral. Have a child explain what five means in terms of the "one-more" idea.

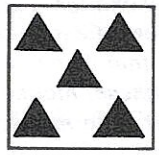


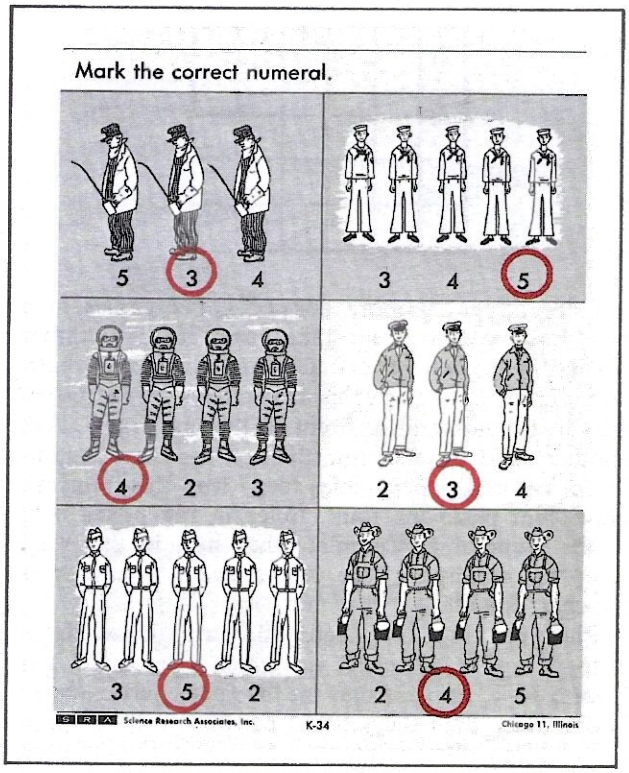
Direct the children to identify the elements in each set. Say that they must think carefully about the number of each set; if a set contains five and only five objects, they are to mark the set. If it seems necessary to work with the children as they mark the sets, do so.

▶ Work page K-34 gives the children a chance to choose from an unordered set of numerals the one which belongs with the given set of pictures. It may be helpful to work with the children as they use this page. Have them place their 2″ x 8″ markers under the first two boxes. Direct them to look at the set of locomotive engineers. Ask one child to read the three numerals in this box. Direct the class to mark the numeral that stands for the number of the set. Follow the same procedure for the other sets on the page.

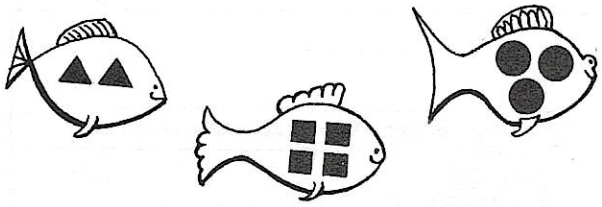
Supplemental Experiences

▶ Distribute cards on which are pictured sets of less than six. Pass out to other children cards on which appear numerals 1 through 5. Place a set of four on the flannel board. Have any child who has a picture card or a numeral card which belongs with the given set to come to the front of the group. Ask each child to tell the number of his set or the number for which his numeral stands. Continue the activity, using many different sets on the flannel board.





▶ Construct a "fish pond." In it place paper fish on which are drawn sets of less than five. Attach a paper clip to each fish. A magnet suspended from a fishing pole will attract the clip. As a child catches a fish, ask him to place it in a container on which appears the appropriate numeral.



▶ Tell the story of "Fred and His Fishes." Use the flannel board to illustrate the action as the story unfolds.

*FRED AND HIS FISHES**

Fred had a fishbowl.
In it was a fish,
Swimming around with a swish, swish, swish!
Fred said, "I know what I will do.
I'll buy another and that will make___."
(Have the children give the missing word.)

Fred said, "I am sure it would be
Very, very nice if I just had___."

Fred said, "If I just had one more,
That would make one, two, three,___."

Fred said, "What fun to see them dive,
One, two, three, four,___."

How many fishes do you see?
How many fishes? Count them with me!

▶ "Purple Violets" is another verse that can be illustrated on the flannel board as the story is told.

PURPLE VIOLETS

One purple violet in our garden grew;
Up popped another, and that made two.

Two purple violets were all that I could see;
But Billy found another, and that made three.

Three purple violets—if I could find one more,
I'd make a wreath for Mother, and that would make four.

Four purple violets—sure as you're alive!
Why, here is another! And now there are five!

▶ Read stories about the number five: *The Five Chinese Brothers* by CLAIRE HUTCHET BISHOP (New York: Coward-McCann, Inc., 1938) or *Five Puppies for Sale* by ESTHER BRANN (New York: Macmillan Co., 1948).

Numbers and Numerals

ONE THROUGH FIVE
1 THROUGH 5

Work Pages K-35 and K-36

Objectives

To re-emphasize the concept of one-more with sets of one through five.

To create a feeling for the natural order of the whole numbers.

Fundamentals

In developing any new concept, the teacher must occasionally pause to show the children how far they have come. The kindergarten child is especially in need of this kind of guidance.

The skillful teacher takes time out to pull together ideas to which she has exposed the child. She realizes that the five-year-old is able to draw conclusions and to make simple generalizations if he is given the right opportunities.

Having the child use known facts, the teacher leads him to draw an important conclusion regarding the order of the whole numbers. The child knows that each number is one more than the number which precedes it. The teacher leads him to conclude that each number is one less than the number which succeeds it.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Order—Relations—Operations.

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Readiness for Understanding

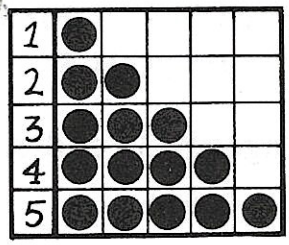
Ability to think of the natural order of the whole numbers.

Developmental Experiences

MATERIALS	VOCABULARY
2 large pieces of construction paper	one more
crayon	one less
colored paper circles, 1″ in diameter	
paste	

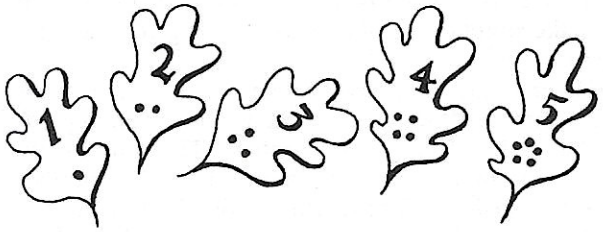
▶ Divide a large piece of construction paper into five rows. In each row mark off six boxes. With a crayon write the numerals 1 through 5 in the first column.

Put fifteen or more colored paper circles in a box. Have a child take from the box the number of circles needed to go with the first numeral on the chart. Ask the child to paste his one circle in the box next to the numeral 1. Point to the numeral 2. Ask another child to take from the box the correct number of colored circles to go with this numeral. Have him paste his two circles in the first two boxes next to the numeral 2. Fill in the rest of the chart in this way. Keep the children aware of the *one-more* pattern as the chart is built.

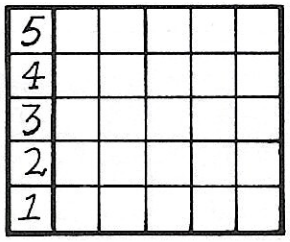


▶ Write the numerals from 1 through 5 on paper leaves. Draw the corresponding set of dots on each leaf. Prepare the leaves so that they will adhere to the flannel board. Place the leaves in a helter-skelter fashion on the flannel board. Tell the children that the wind scattered the leaves and that they must put them in order. This activity may be repeated five or six times.

Vary the activity with the leaves. Line up the paper leaves, in order, on the flannel board. Tell the children to close their eyes. Remove one of the leaves, and ask the children to tell you which leaf is missing.



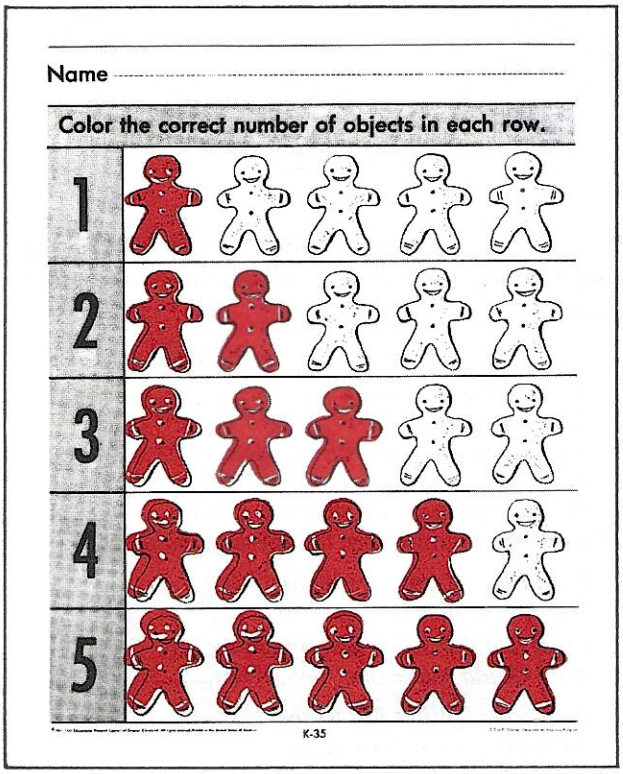
▶ Divide another large piece of construction paper into five rows and six columns. Write the numerals 5 through 1, in descending order in the first column.



Place fifteen or more colored paper circles in a box, and have a child take from it the number needed to go with the first numeral on the chart. Ask the child to paste his five circles in the boxes next to the numeral 5. Point to the numeral 4. Ask another child to take from the box the correct number of colored paper circles to go with this numeral. Have him paste his four circles in the boxes next to the numeral 4. Complete the chart in this way. Keep the children aware of the *one-less* pattern as the chart is built.

Place the chart on which children build sets from 1 to 5 beside the chart on which they build sets from 5 to 1. Explain that on the first chart each set is one more than the set that comes before it. Have the children observe that on the second chart each set is one less than the set that comes after it. Lead them to the conclusion that each number in the natural order of the whole numbers is one more than the number that it follows and one less than the number which follows it.

▶ Work page K-35 gives the children an opportunity to observe the one-more pattern of the whole


Name .....

Color the correct number of objects in each row.

1
2
3
4
5

K-35

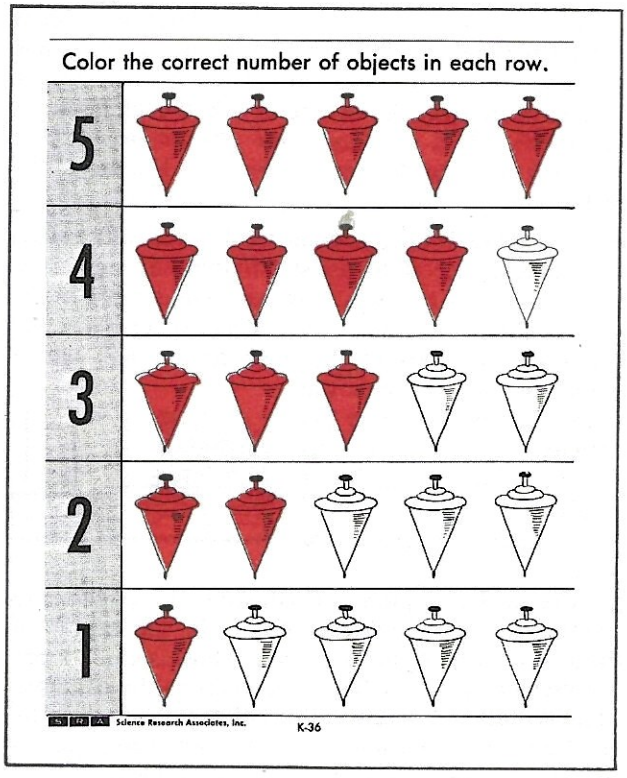
★ More than one correct answer is possible for each problem.

numbers. Have them look at the first row. Ask them to tell you what numeral they see. Direct them to color the number of gingerbread men that the numeral stands for. Follow the same procedure for the second row. Encourage the children to complete the rest of the page by themselves. When every child has finished, discuss the one-more pattern that will have become evident.

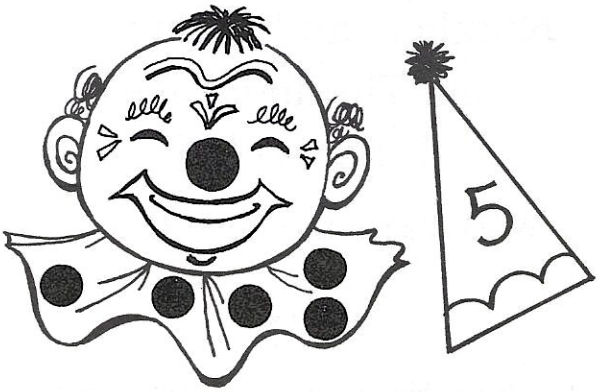
▶ Work page K-36 gives the children an opportunity to observe a one-less pattern. Proceed in the same manner as suggested for work page K-35. When every child has finished, discuss the one-less pattern that will have become evident.

Supplemental Experiences

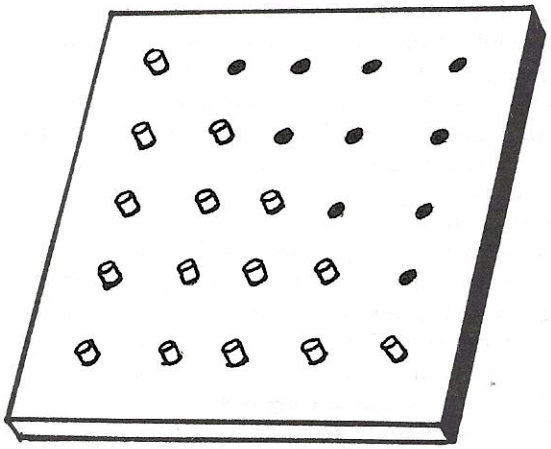
▶ Cut out five clown faces, each with a large ruffled collar under its chin. On one ruffle, paste a red circle; on another ruffle paste two red circles; on the third, fourth, and fifth ruffles paste three, four, and five circles, respectively. Make five clown hats. Write the numeral 1 on one hat, 2 on another hat, 3 on a third hat, 4 on a fourth, and 5 on a fifth. Attach a bit of flannel or sandpaper to the backs so that the hats and the clown faces will adhere to the flannel board. Scatter the clown faces on the left half of the flannel board. Scatter the clown hats on the right half of the board. Have one child unscramble the clown faces and place them in order, one through five, according to the number of red circles on the ruffles. Have another child unscramble the hats and place each on the appropriate clown's head. Continue the activity as long as interest is sustained.



★ More than one correct answer is possible for each problem.



▶ Use a peg board to have the children build up sets, in order, from one to five. Have them also build sets from five to one which show the one-less pattern.



▶ Children will enjoy learning a poem that emphasizes the one-less pattern. Place related felt cutouts on the flannel board as the children recite the poem.

*FIVE LITTLE SEASHELLS**

Five little seashells lying on the shore;
Swish! went the waves, and then there were four.

Four little seashells cozy as could be;
Swish! went the waves, and then there were three.

Three little seashells all pearly new;
Swish! went the waves, and then there were two.

Two little seashells sleeping in the sun;
Swish! went the waves, and then there was one.

One little seashell left all alone
Whispered "Shhhhhhhh" as I took it home."

*Reprinted from *Rhymes for Fingers and Flannelboards*, Louise Binder Scott and J. J. Thompson. Copyright 1960 by Webster Publishing Company.

Numbers and Numerals One Through Five— 1 Through 5

Work Pages K-37 and K-38

Objectives

To help the children develop an ability to compare two numbers.

To help the children understand that the relationship between two numbers can be thought of in two ways (greater than or less than).

Fundamentals

The child observes at an early age that some sets contain more objects than other sets. The five-year-old child has had many informal experiences with sets that are not equivalent. His friend has more pieces of candy than he has. He has more toy cars than his playmate. He soon realizes that there are more elements in some sets than in others.

Although the five-year-old child usually thinks in terms of one set having more elements than another, he can be led to realize that the relationship between sets that are not equivalent can be thought of in two ways. If Billy has more toy cars than John has, John also has fewer cars than Billy has.

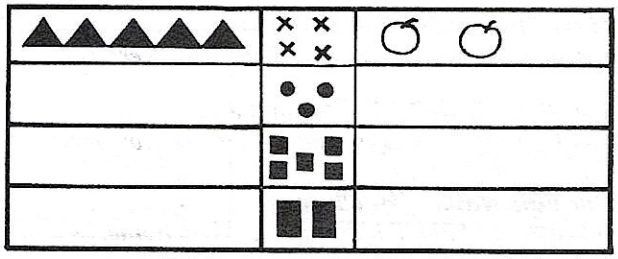
The kindergarten teacher will have the young child make many comparisons of two different numbers and make decisions concerning their relative size. She will do this against the background of sets.

Since not all children will be able to recognize that the number six is greater than the number five or that the number five is less than the number six, it is important to have sets available for comparison. When the child has difficulty with this concept, he will find it helpful to try to match sets, one-to-one, to find out which set has more objects and which set has fewer objects.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Order—Relations—Operations.

Readiness for Understanding

An understanding that not all sets are equivalent. The ability to order numbers one through five.



Developmental Experiences

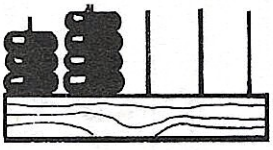
MATERIALS	VOCABULARY
flannel board	more
felt cutouts	fewer
felt numerals 1 through 5	greater than
beads	less than
bead frame	
cards with pictures of sets	
large box	
black paint	
large piece of construction paper	
pictures of sets	
paste	
2″ x 8″ markers for each child	

▶ Arrange two sets which are not equivalent—three circles and five squares—on the flannel board. Have the children determine the number of each set and place the correct numerals under the sets. Ask the children to tell which set has *more* things in it. Explain that the number of the set of squares is *greater than* the number of the set of circles. Say that five is greater than three.

As a second step, arrange a set of two squares and a set of four triangles on the flannel board. Again have a child determine the number of each set and place the correct numeral under each set. This time ask them to tell which set has *fewer* objects in it. Explain that the number of the set which contains the fewer objects is *less than* the number of the other set.

Alternate the two approaches described when having the children compare other pairs of sets that are not equivalent. Use no set whose number is greater than five. At one time ask the children to determine which set has fewer objects; at another time ask them to determine which set has more objects.

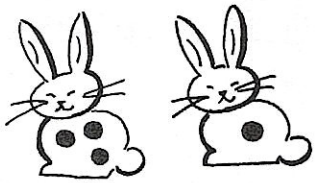
▶ If a bead frame, similar to the one illustrated, is available, use it to assist children in comparing the numbers of two sets. Give one child three beads and another child four beads. Have them place the beads on two rods of the bead frame. Ask which child has the set with the fewer objects. Continue the activity asking which set has more or which set has fewer beads. Have the children tell which number is greater or lesser.



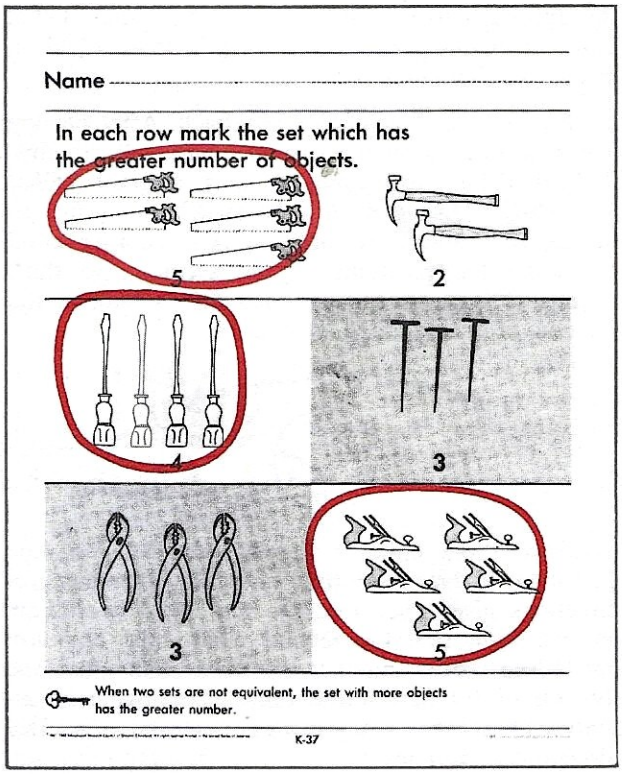
▶ Use a large piece of construction paper and prepare a "more-and-less" chart. In the center of the chart paste pictures of sets whose numbers are not greater than five. Show the chart to the children. Point to the first set at the top of the chart. Ask the children to tell the number of the set. From an assorted collection of pictures of sets, have a child choose one that has more objects than the given set.

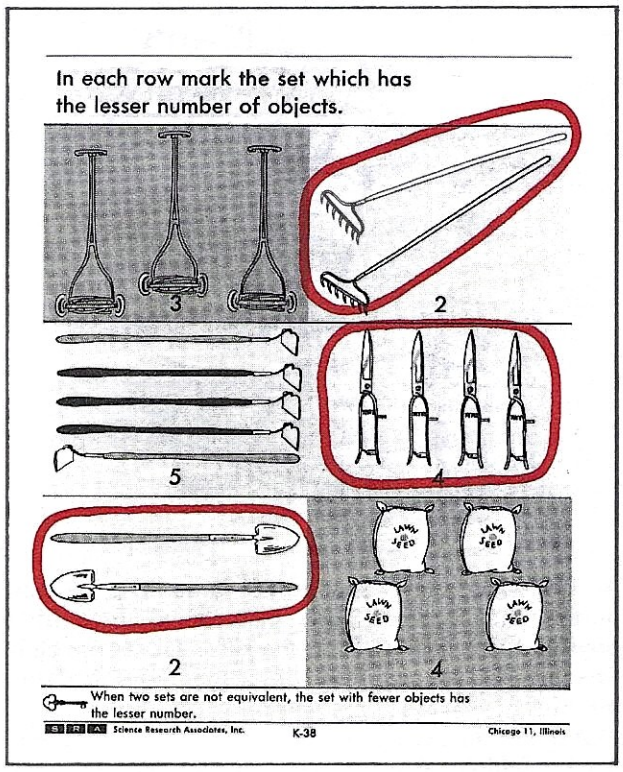
Ask him to tell the number of the set he chose. Direct the child to paste his set to the left of the given set on the chart. Ask another child to choose a set that has fewer objects than the given set. Have him tell the group the number of the set he chose. Tell the child that he must paste his set to the right of the given set. Continue in this manner until all of the given sets on the charts have been compared to sets that have more or fewer objects than the given set has.

▶ Design a large cardboard box to resemble a magician's hat. Paint the hat black. Inside the hat, put several cards with pictures of sets, one through five. The cards can be cut in the shape of rabbits to add interest. Have two children pull rabbits out of the hat. Ask them to tell which of the sets has more (or fewer) objects; ask them to tell which set has the greater (or lesser) number.



▶ Work page K-37 provides the children with an opportunity to practice comparing pairs of sets that are not equivalent. Children have the chance to determine which set has the greater number. Have the children place their markers under the first row of pictures. Ask one child to tell how many saws are





in the one set. Ask another child to tell how many hammers are in the other set. Direct the children to mark the set that has the greater number of objects. Summarize by saying that the number five is greater than the number two.

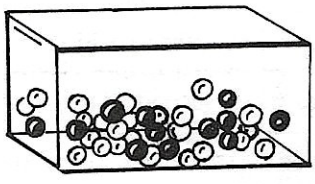
Tell the children to place their markers under the sets in the second row. After they determine how many screw drivers are in the one set and how many nails are in the other set, direct them to mark the set that has the greater number of objects. Ask some child to tell which number is greater. Have him use a complete sentence: "Four is greater than two."

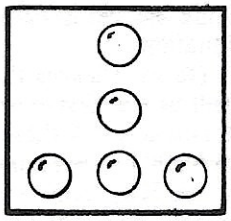
Continue in the same way with the sets in the third row.

▶ Work page K-38 gives the children an opportunity to determine which set has the lesser number. Follow the same procedure suggested for work page K-37. On this page, however, emphasize the set which has the lesser number of objects.

Supplemental Experiences

▶ Hold up a large picture card on which appears a set whose number is less than six. From a container of wooden beads, ask a child to choose a set whose number is greater (or less) than the number of the given set.





▶ Construct a large shoe to use in an "Old Woman in the Shoe" game. Tape pictures of three little boys and two little girls on the shoe. Direct the children to observe carefully the set of boys and the set of girls.

Ask the class to tell which set has the greater number of children. After the class decides on a set, take the two sets from the shoe and line them up on the flannel board. Have some child try to match the boys one-to-one with the girls to see whether the class was correct or not. Repeat the activity, placing a different number of boys and girls on the shoe.

Ordinals: First-Fourth

Work Pages K-39 and K-40

Objectives

To develop an understanding of the use of numbers to denote position.

To teach the use of the ordinal numerals first, second, third, and fourth.

Fundamentals

The five-year-old is still very much in an egocentric stage of development. The socializing process has only begun for him at the kindergarten level.

This young child still thinks, for the most part, in terms of "me first." Even if he does not express it in so many words, he wants to come before anyone else. Although he does not realize what it means in a mathematical or formal sense, he has begun to think in terms of relative position in a particular situation.

He soon learns that in any row, other positions as well as the first position, have special names. Mathematicians call these names (first, second, third, and so forth) ordinal numerals.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Order—Relations—Operations.

Readiness for Understanding

Ability to count to four.

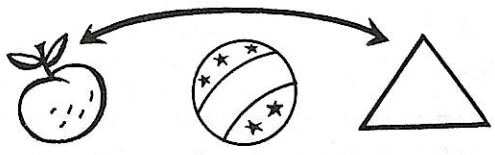
Developmental Experiences

MATERIALS	VOCABULARY
flannel board	first
felt cutouts	second
	third
	fourth
	position

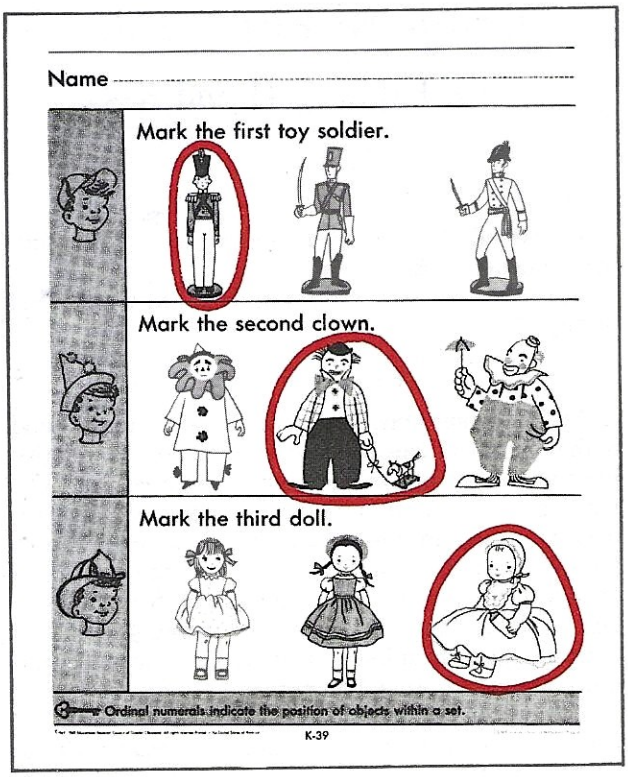
▶ Place three objects on the flannel board. Establish a beginning point to the left of the first object, for in a row of objects it is possible to think of "first" as being either to the left or to the right. Since the five-year-old is not left-to-right oriented, he is apt to begin at the point adults think of as the end position in a row. Pointing to each object in turn,

explain that the rabbit is the first object in the row, that the bird is the second object in the row, and that the kitten in the third object in the row. Continuing this activity, change the objects around so that no given one is associated with any one position. Using the left side of the flannel board as the starting position, ask one child to point to the first object. Ask another child to point to the second object. A third child may point to the third object. Vary the approach to this activity. Tell the children that you are thinking of the bird. Ask some child to tell its position in the row.

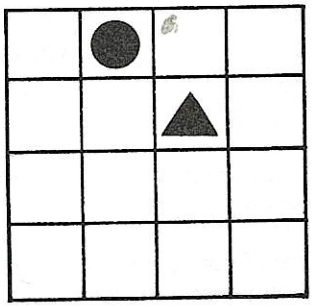
▶ Present a more complex approach. After placing a row of objects on the flannel board, tell the children that they are going to play a game called "Switch-O." Ask one child to switch the positions of the first and third objects. Ask another child to switch the positions of the second and third objects. The game can continue for as long as the interest of the children is evident.



▶ Have three children stand before the group. Tell them to listen carefully and then to follow the directions given. Say that the first child must hop on one foot, that the second child must clap his hands two times, and that the third child must pat the top of his head three times. Continue the activity with another group of three children. Vary the directions each time.


Name
Mark the first toy soldier.
Mark the second clown.
Mark the third doll.
Ordinal numerals indicate the position of objects within a set.
K-39

▶ Use work page K-39 to give practice in the use of the ordinal numerals first, second, and third, to indicate the position of objects within a set. Direct the attention of the children to the Happy Helper at the beginning of each row. Tell them that he will be their friend and help them to find the place to start in each row. Direct the children to look at the row of toy soldiers. Have them put their fingers on the Happy Helper at the beginning of this row. Explain that they are to start at this point. Direct the children to take a crayon and mark the first toy soldier. Work with the group and continue in this way for the second and third row of pictures.



▶ Next, develop understanding of the ordinal numeral, *fourth*. Draw a large square on the chalkboard. Divide it into four rows. Mark off four boxes in each row. Have a child come up to the chalkboard and point to the first (top) row of boxes. Tell him that he must draw a circle in the second box in this first row. Ask a second child to come forward and point to the second row. Have him draw a triangle in the third box in this row. Continue in this manner until all of the boxes in each of the four rows are filled with some object. Now have the children use the pictures to play a guessing game. A child names an object and chooses a second child to describe its position by row and box. As a variation, the child who is "It" describes the position and chooses a child to tell what object is in that box.

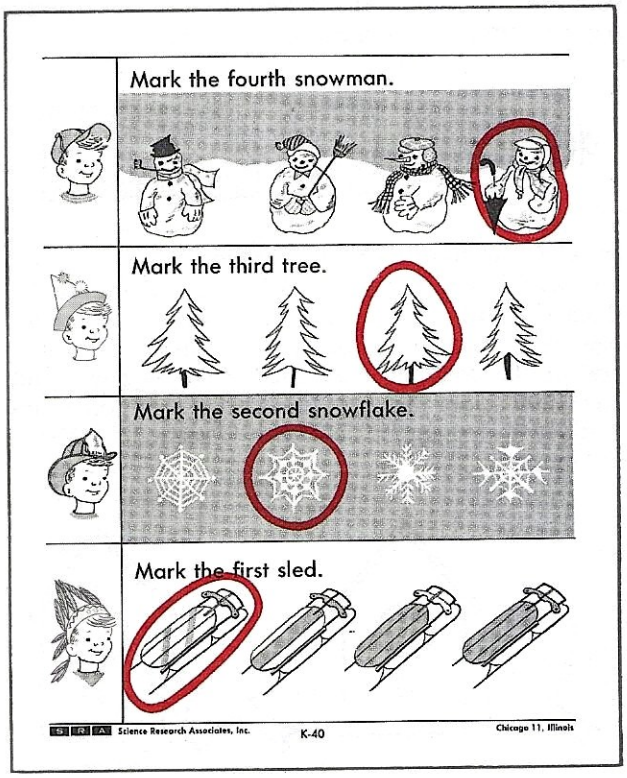
▶ Follow the procedure suggested for work page K-39 when having the children do work page K-40. When the children complete the work page, discuss with them the pattern that emerged as they marked, in order, the fourth object, the third object, the second object, and the first object in the rows.

Supplemental Experiences

▶ Teach the children poems that emphasize ordinals, first through third. Place felt cutouts on the flannel board to illustrate the positions described in the verses.

*THIS LITTLE CLOWN**

The first little clown is fat and gay;
The second little clown does tricks all day;
The third little clown is strong and tall;
I like the clowns, I like them all.

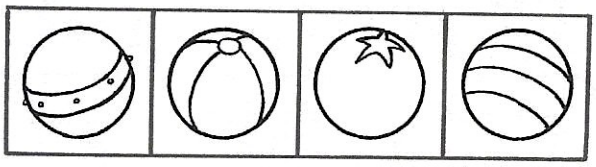


*Adapted from "This Little Clown," *Rhymes for Fingers and Flannelboards,* by Louise Binder Scott and J. J. Thompson. Copyright 1960 by Webster Publishing Company.

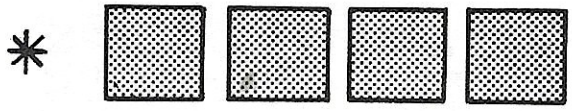
*LITTLE KITTENS**

Three little kittens; see them play.
The first is brown, the second gray.
The third one has soft paws and a wee little nose;
He hears a noise, and away he goes.

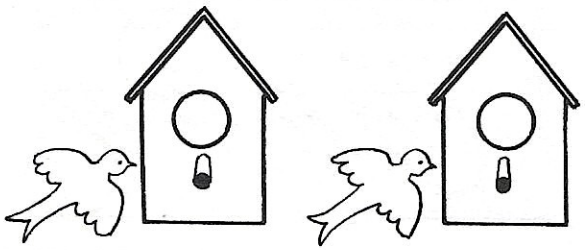
▶ Distribute 4″ x 9″ papers that have been marked off into four boxes. Have the children draw a red ball in the third box. Tell the children to make a blue ball in the first box. Direct them to draw a green ball in the second box, and a yellow ball in the fourth box.



▶ Tape four large paper squares to the floor, arranging them about fifteen inches apart. With a piece of colored chalk put a mark before the first square to indicate the beginning point. Have children sit in a circle around the squares. Call on one child to bounce a ball twice on the second square. Have another child bounce the ball once on the first square. A third child can bounce the ball three times on the third square, and a fourth child can bounce the ball four times on the fourth square.



▶ Cut out four tagboard birdhouses and several tagboard birds. Fix each so it will adhere to the flannel board. Place the birdhouses in a straight row on the flannel board. Distribute the birds to several of the children. Call each child by name and have him place his bird next to a birdhouse according to designations of "first," "second," "third," or "fourth."



Ordinals: First-Fifth

Work Pages K-41 and K-42

Objectives

To extend the understanding of the use of numbers to denote position.

To teach the use of the ordinal numerals first through fifth.

Fundamentals

An important concept for the child to understand is that numbers can be used to indicate the relative position of an object in a given ordered set. The kindergarten teacher tells the child that when numbers are used in this sense, he need not concern himself with the number of objects in a set, but only with the position which given objects have in it. She explains that the names or numerals used to indicate these positions, such as first, second, and third, are called ordinal numerals.

Through actual experience, the teacher leads the child to realize that the number five can indicate that he is fifth in line, for example. This fact alone, however, does not indicate to the child how many children are in the line. His teacher helps him understand that he needs additional information, such as that he is the last one in the line, before he can conclude that this particular set has five children in it.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Order—Relations—Operations.

Readiness for Understanding

Understanding of the positional terms first through fourth.

Ability to count to five.

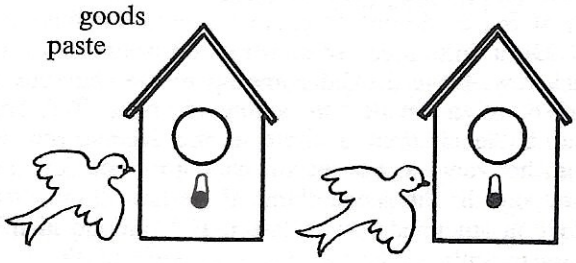
Developmental Experiences

MATERIALS

flannel board
flannel cutouts
paper-cutout latticework that will adhere to flannel board
large piece of construction paper
pictures of various items of baked goods
paste

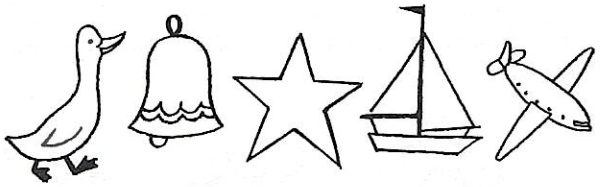
VOCABULARY

fifth



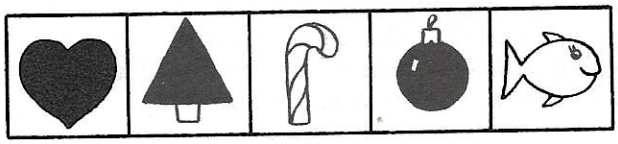
*Adapted from "Five Little Pussy Cats," *Rhymes for Fingers and Flannelboards*, by Louise Binder Scott and J. J. Thompson. Copyright 1960 by Webster Publishing Company.

▶ Place five objects on the flannel board. Remind the children that they are to begin at the left side of the row of objects when determining the relative position of an object in the row. Have one child describe the first object in the row. Ask another to describe the second, another to describe the third, and still another to describe the fourth.



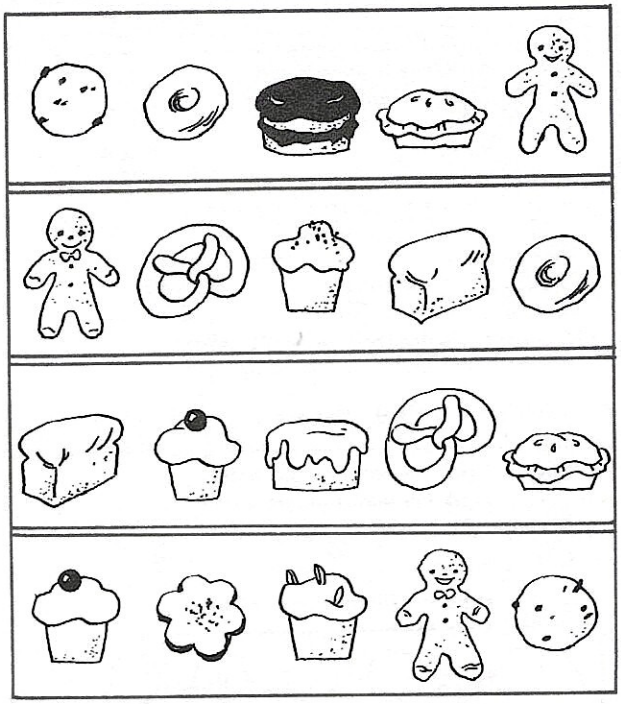
Explain that the last object in this row is in the *fifth* position. Ask if anyone knows the name of the position that comes after first, after third, after fourth. Have someone come forward and point to the object in the fifth position on the flannel board. Change the positions of the various objects in the row. Call upon several children to identify the object that is in a given position.

▶ Fasten a strip of paper-cutout latticework to the flannel board. Place an object in each of five openings. Have the children identify the object in each position, first through fifth. Tell the children to close their eyes while one child comes forward and removes one of the objects. After they have opened their eyes, have the children determine the position of the box that is now vacant. Repeat the activity several times.

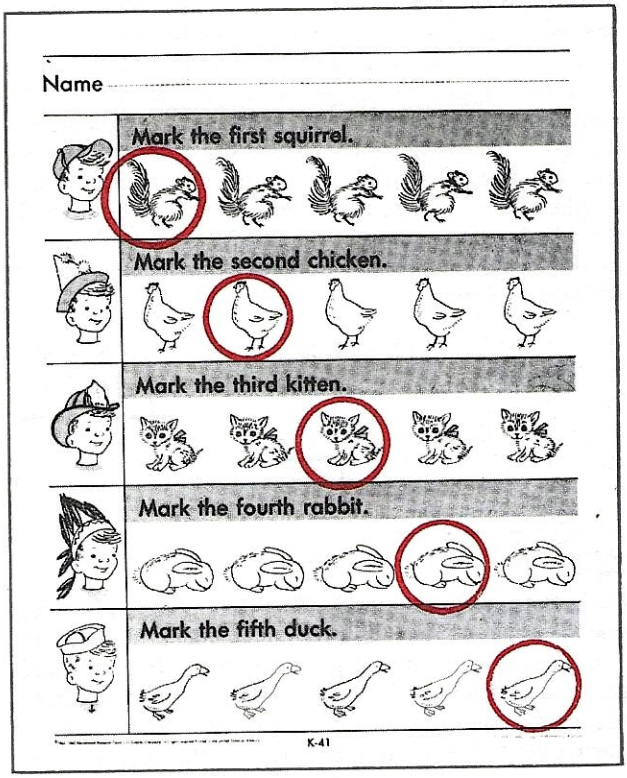


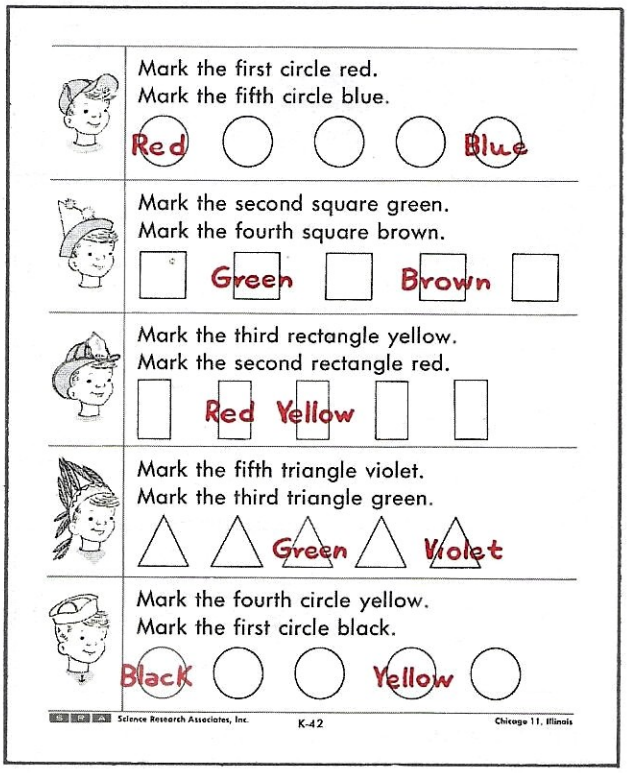
▶ Place seven objects in a row on the flannel board. Give a duplicate set of the objects to seven children. Tell the group that you are thinking of the object that is fifth in the row. Have the child who has the object just like the fifth one come forward and place it on the flannel board just above the given object. Continue in this way until the first five objects on the flannel board have been matched. Now change the position of the objects so that those children who have the remaining ones will be able to participate. Give the other five duplicates out once more, and proceed with the activity.

▶ On a large piece of construction paper mark off four rows. In each of the rows paste five pictures of baked goods. Hold the simulated bakery shelves before the children. Have one child tell about the item he wants to buy by describing its position. He may say that it is the thing in the first (top) row. Have another identify the item. He may say that it is the chocolate cake.



Present work page K-41 to the children to give practice in the use of ordinal numerals. Remind the children that Happy Helper appears at the beginning of each row to help them know where to start. Tell the children to look at the row of squirrels. Direct them to mark the first squirrel in the row. Call their attention to the row of chickens. Have them mark the second chicken. Continue in this manner, row by row. When the children have completed work on the last row, hold up one of the papers. Ask if anyone sees a pattern. Lead the children to observe the "one-more" pattern that is in evidence.

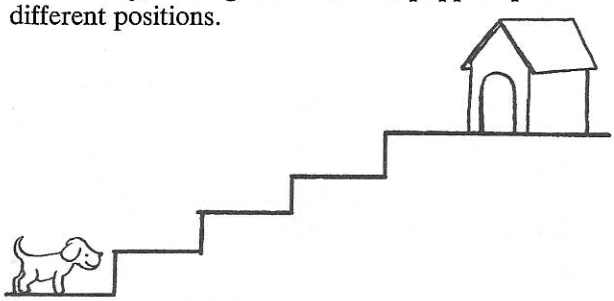




Work page K-42 provides additional experience with the use of ordinal numerals. The procedure suggested for work page K-41 will apply here also. Note that the directions for each row are more complex than those on work page K-41. Carefully guide the children each step of the way.

Supplemental Experiences

▶ For flannel board use, make five tagboard puppies: a brown one, a black one, a white one, a black and white one, and a brown and white one. Cut out a tagboard doghouse and fix it to adhere to the flannel board. Place the doghouse on the flannel board and run a piece of yarn in stair-step fashion up to the opening of the house. Give the five puppies to five children. Tell the child with the white puppy to place it on the second step. Have the child with the black puppy place it on the fifth step. Continue in this way, having the different puppies placed in different positions.



▶ Inflate five balloons of different colors. Give one to each of five children. Ask these children to come to the front of the group with the balloons and arrange themselves in a row. Have some child from the group describe the position, in the row, of a particular balloon. He may say that the blue balloon is fifth in the row. This child may then take the place of the child who held the blue balloon. Call on a second child to describe the position of a balloon of another color. If he describes the position correctly, he may take the place of the child who held this balloon. Continue in this manner until the position of each of the five balloons is correctly stated.

▶ Dramatization of poems is always a source of enjoyment for the five-year-old. Two little verses about puppies and about chicks offer possible source material.

*FIVE LITTLE PUPPIES**

Five little puppies were playing in the sun;
The first one saw a rabbit, and he began to run;
The second saw a butterfly, and he began to race;
The third one saw a pussycat, and he began to chase;
The fourth one tried to catch his tail, and he went round and round;
The fifth one was so quiet, he never made a sound.

THIS LITTLE CHICK †

The first little chick ate corn today;
The second little chick ate worms, they say;
The third little chick ate yellow meal;
The fourth little chick ate potato peel;
The fifth little chick, like a fluffy ball,
Ate a teeny, tiny bit of all!
Corn today! Worms they say! Yellow meal! Potato peel!

Numbers and Numerals

Six—6

Work Pages K-43 and K-44

Objectives

To teach the meaning of the number six.

To provide practice in recognizing sets containing six objects.

To help children learn to recognize the numeral 6 and relate it to sets of six.

To help children begin to see different subsets within the set of six.

*Adapted from "Five Little Puppies," *Rhymes for Fingers and Flannelboards*, by Louise Binder Scott and J. J. Thompson. Copyright 1960 by Webster Publishing Company.

†Adapted from "This Little Chick," *Rhymes for Fingers and Flannelboards*, by Louise Binder Scott and J. J. Thompson. Copyright 1960 by Webster Publishing Company.

Fundamentals

If the kindergarten child is exposed, through a carefully planned program, to the story of whole numbers, his chances for success are optimal. As the story unfolds, the excitement of discovery increases.

Work with sets goes on and the possibility for the emergence of new ideas grows. As the young child examines a set of six, for example, it is true that his teacher will want him to set the stage in such a way that he has the opportunity to see other subsets in the set of six, such as three and three, four and two, two and four, and one and five. She begins to hint at this new idea and, with it, to stir the imagination of the five-year-old. She encourages him to play with an idea that will lay the foundation for later work with combinations.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Sets and One-To-One Correspondence; Numbers and Numerals; Order—Relations—Operations.

Readiness for Understanding

Ability to recognize sets whose numbers are one through five.

Ability to associate the appropriate numeral with sets whose numbers are one through five.

Ability to count to five.

Developmental Experiences

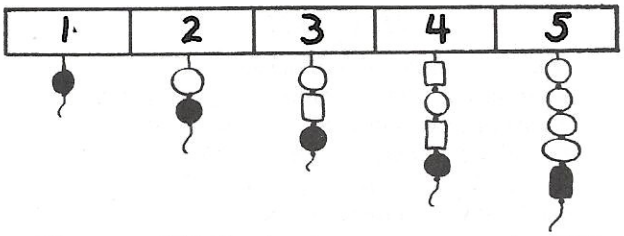
MATERIALS

flannel board
felt cutouts
felt numerals
1 through 6
beads (5 of one color, 1 of another color)
1-foot long piece of string

VOCABULARY

six
set within a set

▶ Call the children's attention to the bead display on the bulletin board, begun at the time of work with sets of one and continued through work with sets of five. Tell the group that it is time to build the next set, the set that comes after five. Ask, "What number do you think this new set will have?"

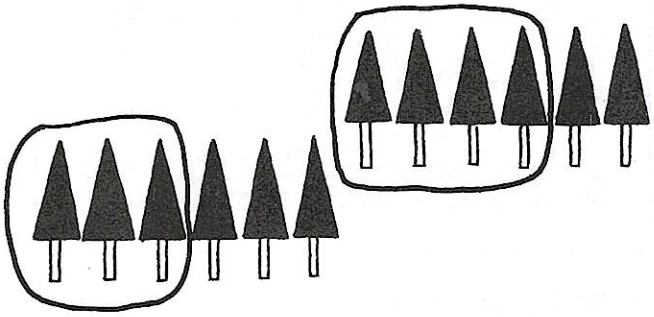


Give one child five beads to put on a string. Help the child tie large knots between beads as he strings them. (When the beads are separated in this way, it is easier, from a distance, to tell how many are in the set.) Ask the class to tell how many more beads are needed to make the new set. Have another child put the "one-more" bead with the set of five beads. Guide the children to conclude that *six* is five and one more. Place the new set, the set of six, next to the set of five on the bulletin board.

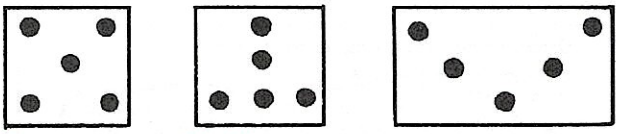
Introduce the numeral 6. Hold up a felt 6 and say that this is the label for the set of six. Place it with the set on the bulletin board.

▶ Place another numeral 6 on the flannel board. Call upon several children to build sets that belong with this numeral. Continue the activity by having the children build sets around the different numerals 1 through 5.

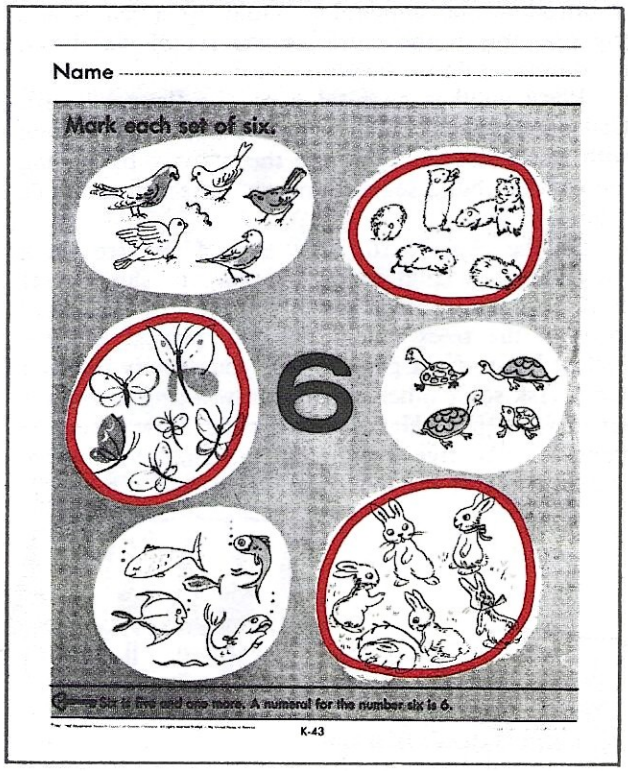
▶ On the chalkboard, draw sets of six trees in a row. Direct a child to draw a ring to show a set of three trees within a set of six. He can circle any three of the trees unless, for the purpose of promoting left-to-right progression, you specify the first three. Ask some other child to draw a ring to show a set of four trees. Have a third child draw a ring to show a set of five trees. Help the children observe that in a set of six it is possible to find other sets.



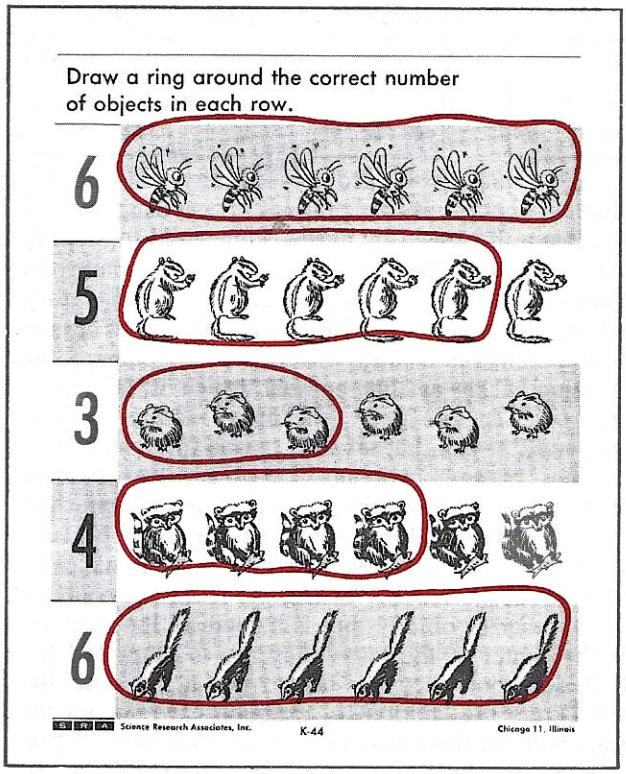
▶ Use large cards bearing pictures of sets of two through six. Hold up one of the cards, the five-card, for example. Ask a child to tell how many are in the set he sees. Ask him if he sees any other *sets within the set* of five. Have some of the sets on the cards carefully patterned so that the less mature children will not find the activity too difficult.



▶ Work page K-43 provides children with an additional opportunity to practice recognizing sets of six. Begin the lesson by asking some child to identify the numeral in the center of the page. Have the children hold up the index finger on the hand they use when they crayon. Tell them to trace the outline of the numeral 6 with this finger. Emphasize the meaning of six as that number which is one more than five. At this point, the more mature children may want to say that six also means three and three to them, or perhaps it means four and two to some of them. Encourage this line of thinking on their part. Tell the children to look at the set of birds at the top of the page. Say that they must think carefully about the number of the set. If the set contains the number of objects that is named by the numeral in the center of the page, they are to mark the set. If it does not, they are not to put a mark on the set. Direct the children to examine each set on the page and tell them that they must mark any set that contains six and only six objects. They are not to mark any other sets.



▶ Work page K-44 sets the stage for finding other sets within the set of six. Have the children point to the row of bees. Ask someone to tell what numeral he sees in this row. Tell the children that they are to draw a ring around the number of objects for which the numeral stands. Continue in this way, row by row, until the entire page is completed. Discuss each row with the children. Ask them to tell what sets they see within each set of six. The fact that they see a set of six within a set of six is most important and is not to be minimized. An understanding of the sophisticated concept that every set is a subset of itself has its beginnings in the kindergarten.



★ More than one correct answer is possible for each problem.

Supplemental Experiences

▶ Give the children continual practice with sets whose numbers are not more than six. Write a numeral from 1 through 6 on one end of each of several wooden tongue depressors. Place the sticks, numeral-end down in a container. Ask a child to come forward and choose one of the sticks, to read the numeral on the end of it, and to build a set on the flannel board that corresponds with the numeral. Give several children the chance to choose sticks and build sets.

▶ Have the children sit in a circle on the floor. Give numeral-cards 1 through 6 to some of the children. Give set-cards 1 through 6 to other children. Play a recording of a march. Call out a numeral and have the child whose set-card matches it march around the inside of the circle and find the child who has the numeral-card for his set. Have these two children march around the outside of the circle while another numeral is called and the game continues.

▶ Children will enjoy learning the song "Six Little Mice" from *The Kindergarten Book* (Boston: Ginn and Co., 1949).

Listening to the story *Six Foolish Fishermen* by BENJAMIN ELKIN, (Chicago: Childrens Press, 1959) will provide another experience with the number six.

▶ Counting kittens can be fun. Have several different children place the correct number of tagboard kittens on the flannel board as the action is depicted in the following verse:

*COUNTING KITTENS**

One little kitten with a furry tail;
Two little kittens lapping milk from a pail;
Three little kittens rolling on the floor;
Four little kittens running out the door;
Five little kittens roll a yellow ball;
Six little kittens and now that's all.

▶ Have the children bring from home pictures of sets, three through six, to paste in the Number Book that was begun with work on sets of one and two. Assign three pages for each of these four different sets. Place the numeral 3 on each of three pages, the numeral 4 on each of three pages, the numeral 5 on each of three pages, the numeral 6 on each of three more pages. Have the children paste their pictures on the correct pages.

*Adapted from "This Little Chick," *Rhymes for Fingers and Flannelboards*, by Louise Binder Scott and J. J. Thompson. Copyright 1960 by Webster Publishing Company.

Numbers and Numerals: 7

Work Pages K-45 and K-46

Objectives

To teach the meaning of the number seven.

To provide practice in recognizing sets containing seven objects.

To help children learn to recognize the numeral 7 and relate it to sets of seven.

To help children begin to see different subsets within the set of seven.

Fundamentals

Under skillful guidance, the child's awareness of the idea of pattern in a number system sharpens. The kindergarten teacher arouses the child's interest in this concept in the familiar setting of geometric shapes. Herein the child repeats the pattern he has observed; he builds one more part in order to continue a pattern.

The seed for understanding of the "one-more" concept was planted early in the season. The "one-more" pattern in the natural order of whole numbers was introduced when the child related the number one to the number two.

The kindergarten teacher must accept the responsibility for continuing to provide an environment in which this seed can germinate slowly but steadily. The five-year-old is now ready to build another set whose number is one more than the last.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Sets and One-To-One Correspondence; Numbers and Numerals; Order—Relations—Operations.

Readiness for Understanding

Ability to recognize sets whose numbers are one through six.

Ability to associate the appropriate numeral with sets whose numbers are one through six.

Ability to see sets within a given set.

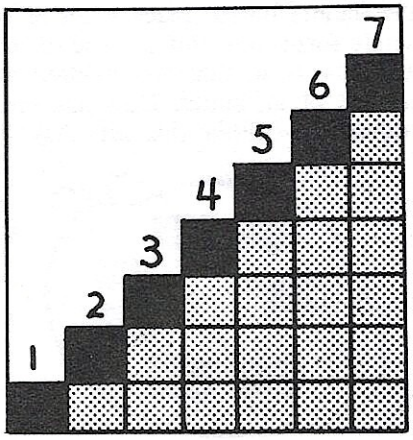
Ability to count to six.

Developmental Experiences

MATERIALS	VOCABULARY
large piece of construction paper crayons flannel board sets of felt cutouts heavy yarn pictures of sets (four, five, six, seven)	seven

▶ Design a "one-more" chart on a large piece of construction paper. Mark off 2″ squares in the manner illustrated. Mount the chart on an easel.

Ask a child to take a red crayon and color the set-of-one block. Write the numeral 1 above the set.

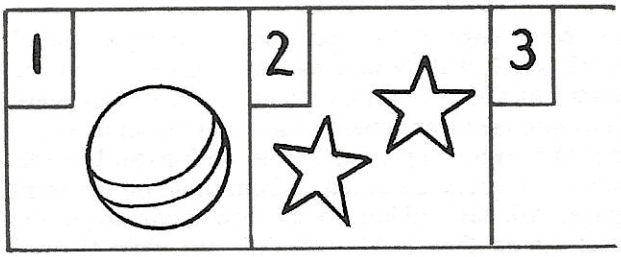


Call upon another child to color the next set of blocks. Ask the class to tell how many blocks are in this set. Direct the second child to use a red crayon and a blue crayon. With the red crayon he must make the "one-more" pattern obvious. Have someone tell the story the block pattern shows: namely, that two is the number that is one more than one. Write the numeral 2 above the set.

A third child may color the next set of blocks after the children have indicated the cardinal number of the set. Have this child again use the blue and red crayons to color the blocks. Remind him that he must use the red crayon to make the "one-more" pattern stand out. Have some other child tell the story that this block pattern shows: namely, that three is the number that is one more than two. Write the numeral 3 above the set.

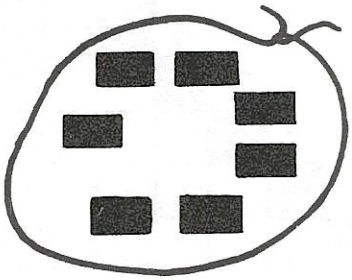
Continue in this way until all of the set-of-six blocks have been colored and the corresponding numerals written. When the time arrives for coloring the set-of-*seven* blocks, discuss this new number with the class. Impress them with the fact that each new set continues to be built in the same way, by beginning with the number of the set which came before and then thinking "one more." Introduce the new numeral, 7, by writing it over the set.

▶ Divide a large area on the chalkboard into seven squares. Write the numerals from 1 through 7 in the upper left-hand corner of the squares. Have each one of seven children draw a set that corresponds to the numeral in one of the squares. While each child draws his set, tell the other children to

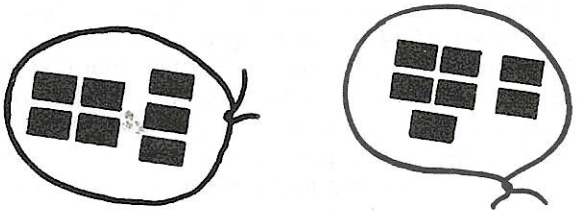


watch closely to see if the set being drawn has the correct number of objects. When the first group of sets has been completed, erase the work and begin again. Give seven other children an opportunity to practice drawing pictures of sets.

▶ On the flannel board, place a set of seven objects in circle formation. Put a piece of heavy yarn around the objects so that the children are led to think in terms of an entity. Now ask the children to find other sets within this set. Ask if anyone



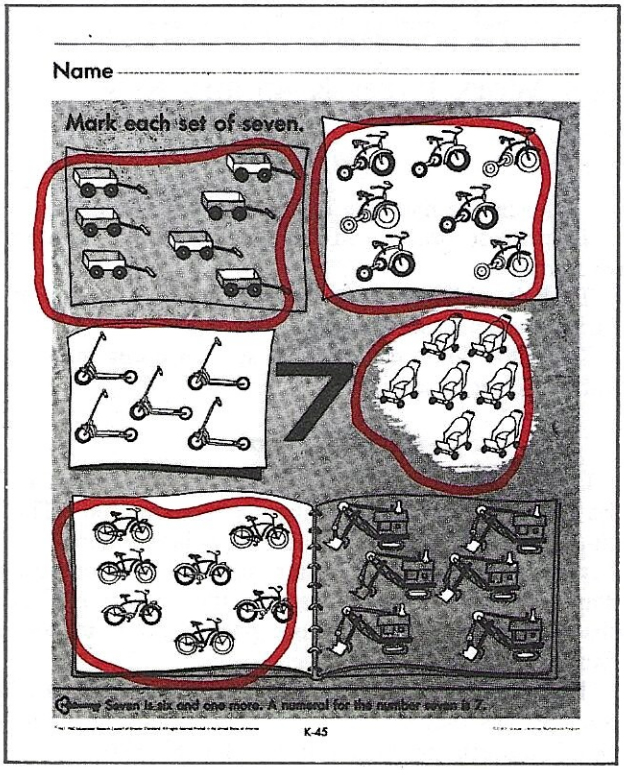
thinks he can rearrange the objects in the set so that it is possible to see other sets within the set itself. Some child may choose to rearrange the elements of the set in such a way that a four-and-three combination appears. Another child may show a five-and-two combination. Continue having children find sets within the set. Help the children conclude that it is always possible to think of other sets within the set of seven.



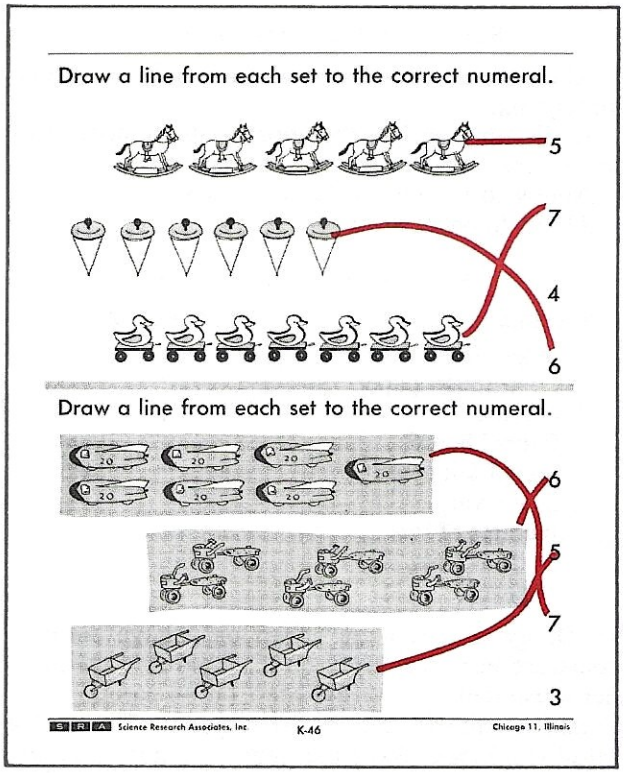
▶ Use work page K-45 to provide an additional experience with sets of seven. It is always possible to use a work page to evaluate the children's progress as well as to develop or reinforce a concept. Have the numeral in the center of the page identified. Direct the children to trace the outline of the numeral with one index finger. Stress that in the natural sequence of the whole numbers, seven is thought of as the number that is one more than six.

Direct the children to examine the set of seven wagons at the top of the page. Tell them to decide if the set contains the number of objects which the numeral on the page represents. If it does, they are to mark the set. Have the children mark each set of seven on the remainder of the page.

▶ Work page K-46 represents an arrangement of work which will be new to the children. Orient the group to this new arrangement. On the chalkboard illustrate the arrangement of sets and numerals which appears on the upper half of the work page. Use sets whose numbers are different from those on the work page. Ask the children to tell how many are in the first set on the chalkboard. Ask one child to read the numerals listed in a column to the right of the sets. Direct another child to come forward and place his finger on the first set on the chalkboard. Have the class search for the numeral that names the number of the set. Have the first child who thinks



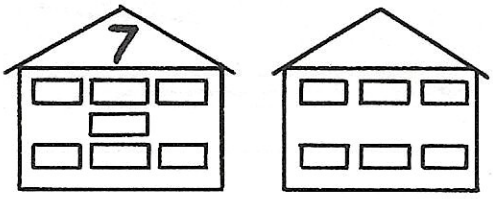
he has found that numeral come to the chalkboard and place his finger on it. Ask someone else to take a piece of chalk and draw a line between the set and the numeral chosen by the child at the chalkboard. Continue having sets and numerals matched in this way. Permit children to discover that one of the numerals was not used; the number of sets and the number of numerals was not the same.



▶ Before the children begin to do work page K-46 they should fold it along the separating line so that they will see only the sets and numerals on the top part of the page. Have them put their finger on the set of rocking horses. Direct them to take a crayon and draw a line from this set to the correct numeral in the column on the right. Continue in this way until the top part of the work page is completed. Then ask the children to turn their papers over so that they see only the lower part of the work page. Follow the same procedure in doing this part of the work page.

Supplemental Experiences

▶ Design seven paper houses. Cut a different number of windows, one through seven, in each of the seven paper houses. Place the houses on the flannel board. Give seven children paper numerals, 1 through 7, and ask them to paste the correct one on each house.



▶ Read stories which emphasize seven in their main theme: *Seven Diving Ducks* by MARGARET FRISKEY (New York: David McKay Co., Inc., 1960) and "Snow White and the Seven Dwarfs."

▶ The song, "Adam Had Seven Sons," from *More Songs To Grow On* (New York: William Morrow & Co., Inc., 1954), can be enjoyed by the children as they learn about seven.

Numbers and Numerals: 8

Work Pages K-47 and K-48

Objectives

To teach the meaning of the number eight.

To provide practice in recognizing sets containing eight objects.

To help children learn to recognize the numeral 8 and relate it to sets of eight.

To help children begin to see different subsets within a set of eight.

Fundamentals

During the time the teacher is developing one idea she also is laying the foundation for what is to come later in the program. Each step of the way, the teacher uses familiar concepts as the basis for developing new concepts. She deliberately centers her thinking around the idea that mathematics is a continuous, growing structure, and she teaches it accordingly.

The time for the informal development of the concept of addition grows closer. While teaching the child about the number eight, the alert kindergarten teacher encourages him to continue his search for sets within sets. She gets the five-year-old ready for what is to come.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Sets and One-To-One Correspondence; Numbers and Numerals; Order—Relations—Operations.

Readiness for Understanding

Ability to recognize sets whose numbers are one through seven.

Ability to associate the appropriate numeral with sets whose numbers are one through seven.

Ability to see sets within a given set.

Ability to count to seven.

Developmental Experiences

MATERIALS

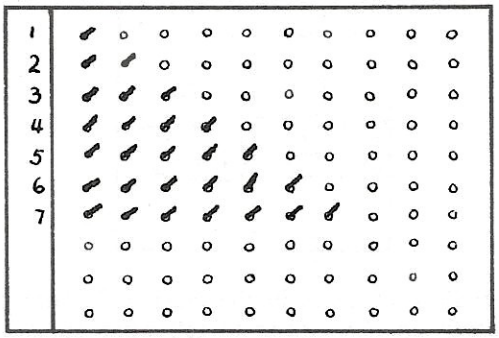
pegboard
wooden pegs
large sandpaper numerals
flannel board
flannel cutouts
heavy yarn
strip of cardboard cut to the width of 2 inches and the length of the pegboard

VOCABULARY

eight

▶ Have children build sets from one through *eight,* in a pegboard. Fasten a 2-inch cardboard strip to the left of the first column of holes.

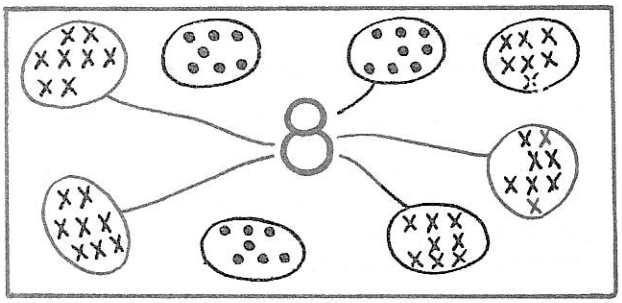
Place a set of one in the first hole in the first (top) row of the pegboard. Have the set named. Write the numeral for it on the cardboard strip next to the set. Direct a child to build, next to the set of one, a set of one more than one. Have the set named. Write the corresponding numeral next to the set of two.



Have several children build sets, in order, from three through seven. Continue to write the related numerals next to the sets. Stress the fact that each set contains one more than the number of objects in the set which came before.

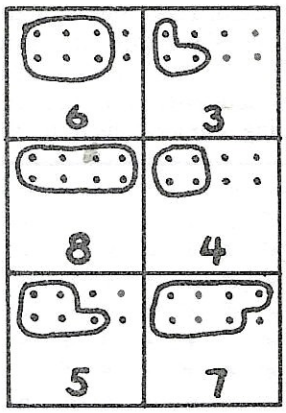
Introduce the numeral 8. Say that this is the name for the number which is one more than seven. Have some child build the set in the pegboard.

▶ Around the edge of the flannel board, have children build sets containing seven or eight objects. Place the numeral 8 in the center of the board. Have a child use a piece of yarn to connect the numeral with any set whose number corresponds with it. Continue in this way until all the sets of eight have been connected, with pieces of yarn, to the numeral.



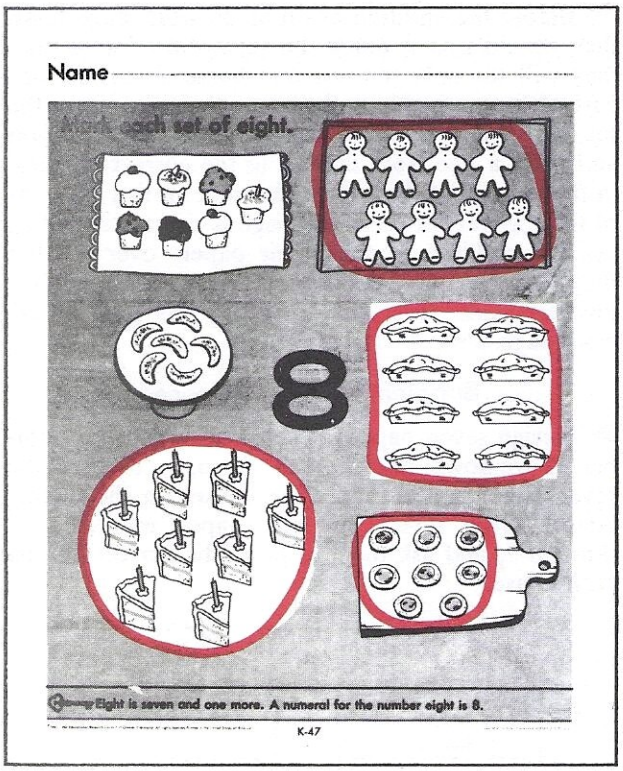
▶ Have a child come up to the flannel board. Tell him to close his eyes. On the flannel board, place a large sandpaper numeral 8, with the rough side facing out. Take the child's index finger and help him trace the outline of the numeral. Have him tell what numeral "he feels." Continue in this way with numerals 1 through 8. Give as many children as possible the opportunity "to feel" the numerals.

▶ On the chalkboard, mark off six large squares. Have six children draw sets of eight in the squares. In mixed order, write the numerals 3 through 7 in the squares. Ask a child to look at the numeral in the first square and to draw a ring around the number of objects the numeral represents. Follow the same procedure with the other sets. When this part of the activity has been completed, discuss the sets within each given set.



▶ Provide each child in the class with work page K-47 Call upon someone to tell what numeral he sees in the center of the work page. Direct the children to trace the outline of the numeral with their finger. Have them "write" this numeral once more, this time in the air. Ask someone to tell what eight means in terms of the "one-more" concept—eight is the number that is one more than seven.

Caution the children to work very carefully and find the number of the set of cupcakes. Have them



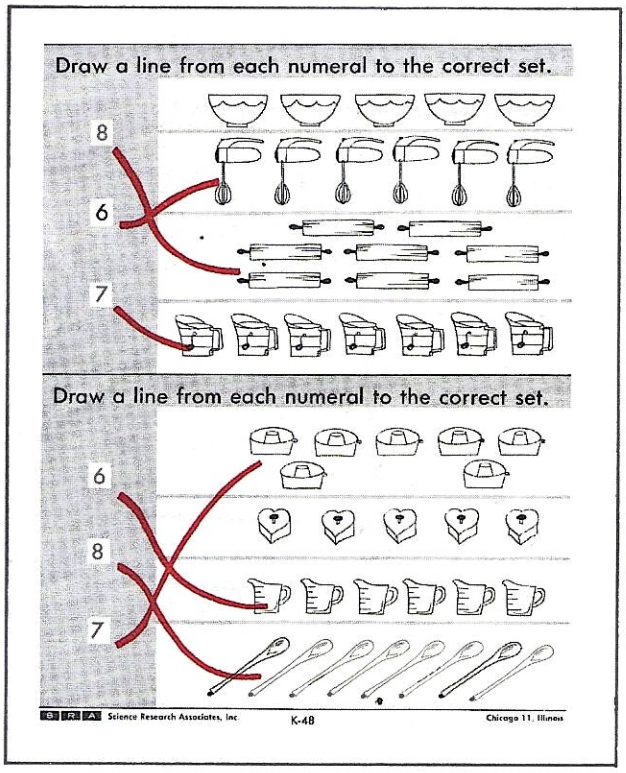
mark the set if it contains the number of objects for which the numeral stands. Tell the children to mark each set of eight on the remainder of the page.

Have the children fold work page K-48 along the separating line so that only the sets and numerals on the upper part will be in view. Have some child read the three numerals. Direct the children to identify each of the four sets to the right of the numerals. Have the children count to themselves to find the set which has eight objects. Tell them to draw a line from the numeral 8 to this set. Proceed in this manner until the upper part of the work page is finished. Now ask the group to turn their work pages over so that they see only the lower part of them. Follow the same procedure as was used in doing the upper part.

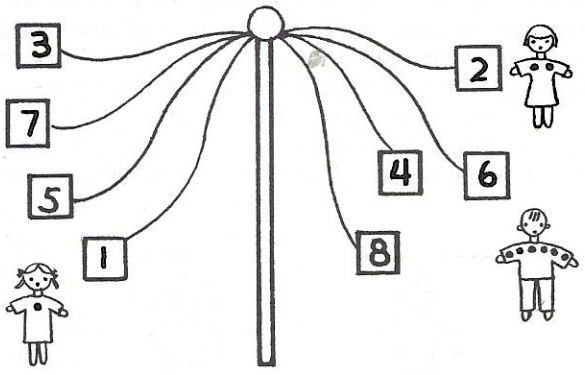
Supplemental Experiences

▶ Have the children sit on the floor in a circle. Mix up a set of cards, some of which have a picture of a set (one through eight) and others of which have a numeral (1 through 8). Give each child one card. Direct the children to hold the cards in such a way that the sets and numerals are in sight at all times.

Choose one child to go into the center of the circle. Call out "set of seven." The chosen child is to skip around the inside of the circle until he finds someone who has a card on which appears a set of seven. He then changes places with the child holding the card and that child goes into the center of the circle to await his instructions. As the game proceeds, alternate the instructions between set cards and numeral cards.



▶ Design a Maypole for the flannel board. Prepare eight cards, each of which has a numeral (1 through 8) on it, and eight paper dolls, each of which has a set of dots (one through eight) drawn on it. Attach the cards to the ends of the ribbons or pieces of yarn leading from the Maypole. Then give each of eight children a paper doll and name a number not greater than eight. The child who has the paper doll with the corresponding set is to match his set to the numeral on the Maypole ribbon. Proceed in this way until all sets and numerals have been matched and eight dolls are dancing around the Maypole. If time permits repeat the activity.



▶ Play the game, "I Am Thinking of a Number." Have a child describe a number for the class to guess. He may say, "I am thinking of the number that is one more than three." The child who guesses correctly may have the next turn. He may call for the number that is one less than seven, the number that comes between six and eight, or some other number from one through eight.

Numbers and Numerals: 1-8

Work Pages K-49 and K-50

Objectives

To help children strengthen their understanding of the concept of counting.

To re-emphasize the order relation between the numbers one through eight.

Fundamentals

In the kindergarten, the child is provided with a program which permits him, from the very start, to investigate the natural order of whole numbers. He learns to make use of his knowledge in this area when he counts.

During the counting process the child names the numbers in a meaningful setting. He does not merely learn the names for numbers but also that there is a one-to-one correspondence between the words being used and the elements in the set being counted.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Order—Relations—Operations.

Readiness for Understanding

Ability to count to eight.

Ability to recognize the numerals 1 through 8.

Developmental Experiences

MATERIALS

12″ strip of tagboard latticework
flannel board
felt numerals 1 through 8

▶ On the flannel board, place a piece of tagboard latticework. Give eight children felt numerals from 1 through 8. Say, "Who has the numeral for the number we use when we begin to count? Come to the flannel board and place it in the first box."

Have the numeral identified and then say, "Who has the numeral for the number that comes next after one?"

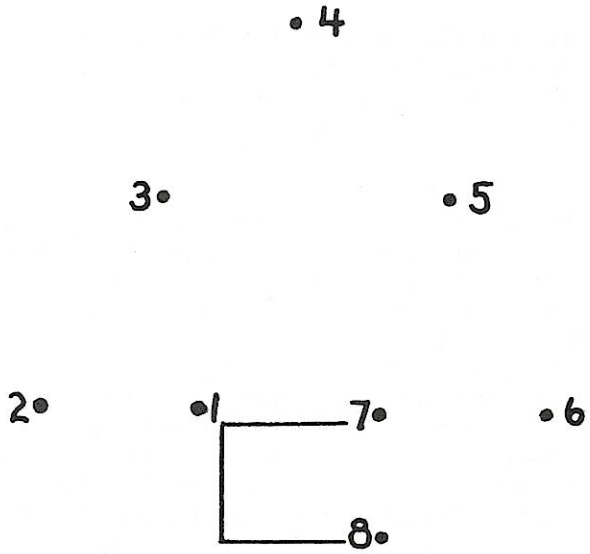
Have the child holding this numeral come forward and place it in the box next to 1. Have him tell what numeral he has. Tell the children that they must decide who has the numeral for the next number. Direct the child who has the numeral to place it, in order, in the latticework frame. Continue in this way until all numerals have been placed in the correct order and have been named correctly.

1	2	3	4	5	6	7	8

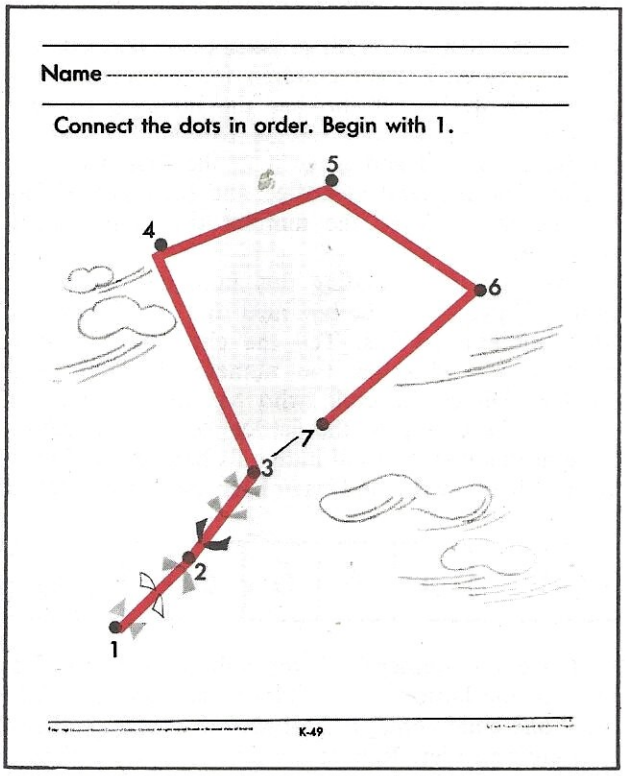
▶ Place the numerals 1 through 8 in scrambled order in the latticework frame on the flannel board. Have one child come to the board and arrange them in counting order. Repeat the activity several times.

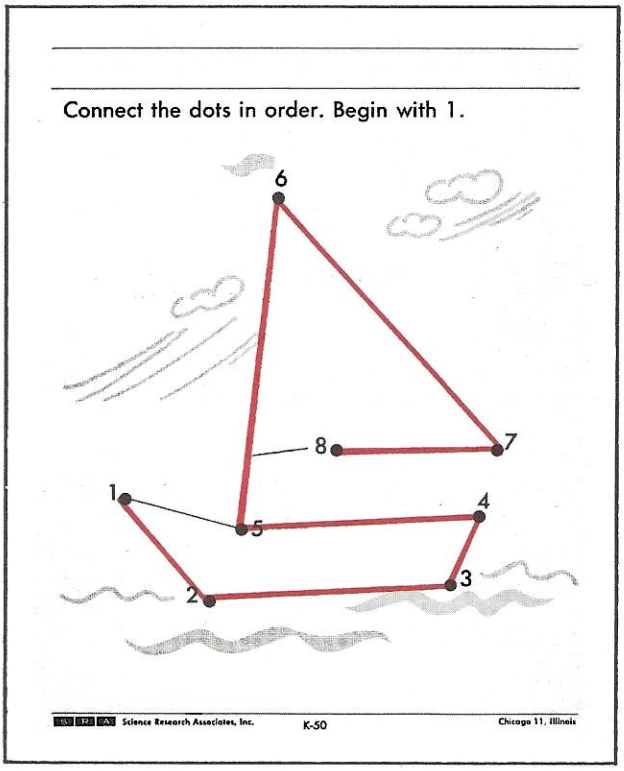
5	3	1	7	2	6	8	4

▶ Place a series of dots and lines on the chalkboard. Design them in such a way that a child can, by connecting the dots, produce a picture.



▶ Use work page K-49 to give children opportunity to strengthen their understanding of the concept of counting. Explain that they are to place their crayons on the first dot. Have some child tell which dot he chose to begin with and why. Tell the children that they are to make a picture by connecting the dots in order. Follow the same procedure for work page K-50

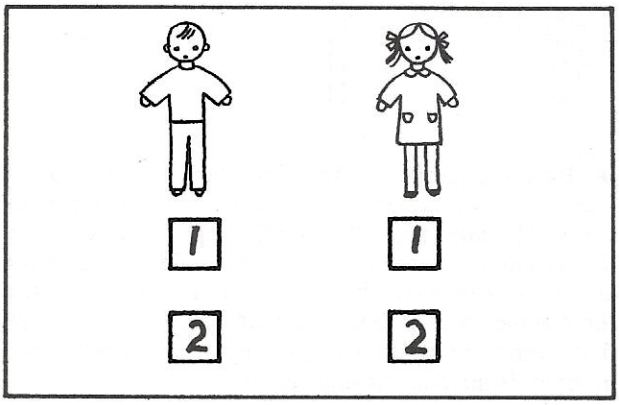




Supplemental Experience

▶ Place two paper dolls at the top of the flannel board. Then give a set of numeral-cards, 1 through 8, to eight boys who will form one team. Provide eight girls, who will form another team, with a duplicate set of these cards. Tell the members of the teams that they are to put their numeral-cards, in counting order, on the flannel board. Girls are to place their cards under a girl paper doll. Boys are to place their cards under a boy paper doll.

On a given signal the two children having the first numeral-cards must come quickly forward and place their cards on the board. When they return to their seats, the children who hold the next numeral cards are to come quickly forward and place their cards under the ones already on the board. No child is to come forward until the teammate who precedes him has sat down again. The children should continue in this way until all numeral cards have been placed on the board. The team that finishes first wins.



Numbers and Numerals: 9

Work Pages K-51 and K-52

Objectives

To teach the meaning of the number nine.

To provide practice in recognizing sets containing nine objects.

To help children learn to recognize the numeral 9 and relate it to sets of nine.

To help children begin to see different subsets within a set of nine.

Fundamentals

The kindergarten teacher must continue to provide a variety of experiences so that the child has every opportunity to gain deeper insight into the fundamental ideas in mathematics to which he is being exposed. Often a seemingly simple activity provides a new view rather than a review of an idea for a particular child. Understanding and meaning broaden and extend as the child uses his knowledge of a specific concept in different situations.

The five-year-old is now ready to examine the "one-more" pattern and the idea of sets within sets, in relation to the number nine. He should be encouraged to use what he already knows and to apply this knowledge in a new setting.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Sets and One-To-One Correspondence; Numbers and Numerals; Order—Relations—Operations.

Readiness for Understanding

Ability to recognize sets whose numbers are one through eight.

Ability to associate the appropriate numeral with sets whose numbers are one through eight.

Ability to see sets within a given set.

Ability to count to eight.

Developmental Experiences

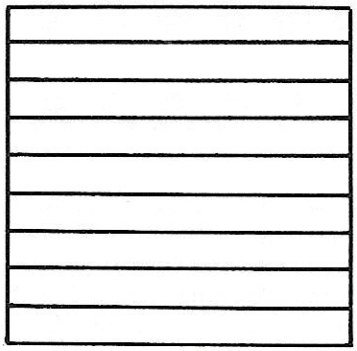
MATERIALS

9 strips of blue construction paper, each measuring 2 inches in width and 2 to 18 inches in length
paste
large piece of construction paper
pins
flannel board
felt numerals 1 through 9
felt counters
pictures of sets

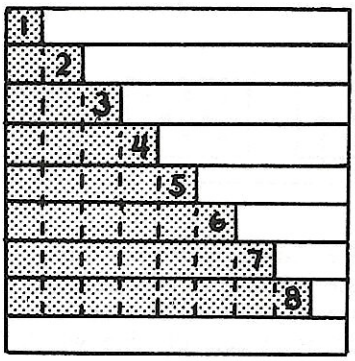
VOCABULARY

nine

▶ On a large piece of construction paper, mark off an 18-inch square. Divide the square into horizontal rows 2 inches apart. From blue construction paper, cut nine strips so that each will be 2 inches wide but vary in length from 2 inches through 18 inches. Mark the strip which is 2 inches long, with the numeral 1. By means of a vertical, broken line, divide the remaining strips into blocks 2 inches long. Mark the last block of the 4-inch-long strips, with a numeral 2, that of the 6-inch-long strip, with a numeral 3, and so forth.

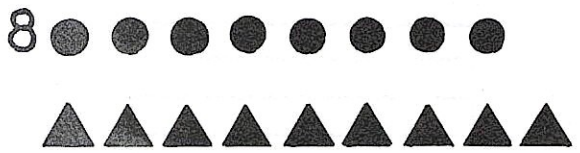


Place the large piece of construction paper on the flannel board. Give the blue strips to some of the children. Tell the child who has the strip marked with the numeral 1, the one-strip, that he may begin a "one-more" chart by pasting his strip in the first row. Have the children continue pasting their strips in order, one through eight, on the chart. Stress the "one-more pattern" each time a strip is pasted. Have each numeral read in turn.



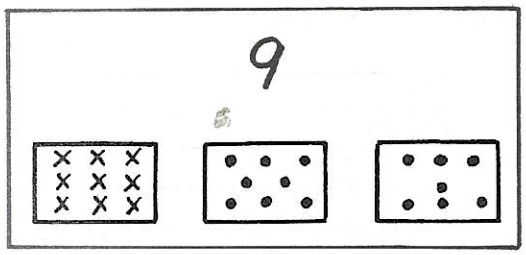
Stop just before it is time to paste on the chart the strip marked with a 9. Take time to introduce the new numeral. Place a felt 9 on the board next to the chart. Say that this is the numeral which will label the number that is one more than eight. Ask if anyone knows what this new number is. After someone has given the name, have the child with the strip marked with a 9 come to the chart and paste it in place.

▶ On the flannel board, build a set of eight. Place the corresponding felt numeral beside the set. Ask someone to build the set whose number is one more than the number of the set now appearing on the board. Have the new set built immediately under the given set. Encourage the child who is building the set to place the elements of the new set in one-to-one correspondence (as far as this is possible) with the elements of the set of eight. Have the number of the new set identified. From a set of numerals

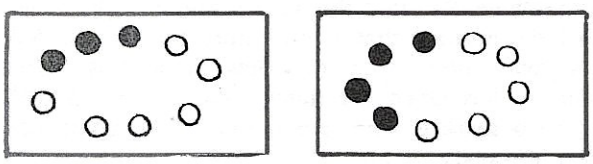


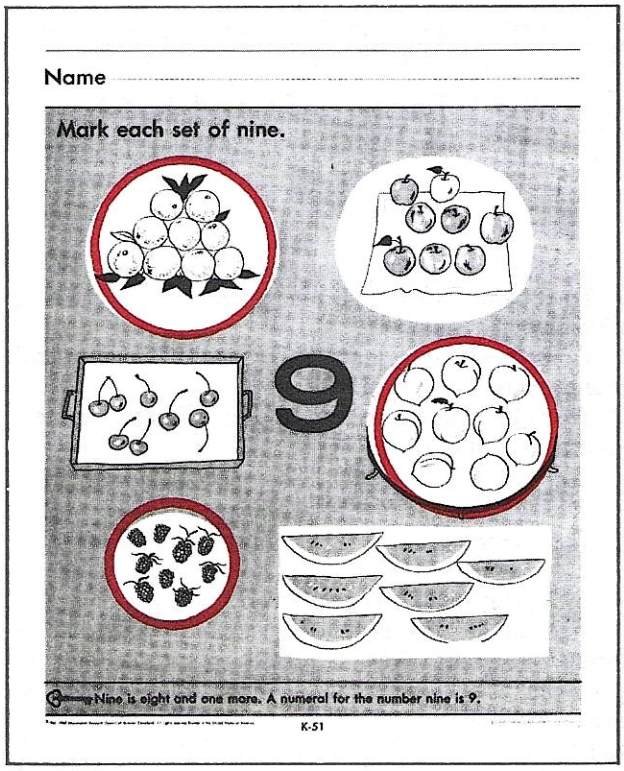
1 through 9, which have been placed in scattered fashion on one side of the flannel board, ask another child to choose the correct one to place with the set of nine. Continue the activity. Build sets whose numbers range from one through eight. Direct several different children to build the set that is one more than the given set. Have the corresponding numeral placed next to each set each time.

▶ On the flannel board place pictures of a set of seven, a set of eight, and a set of nine. Put the numeral 9 on the board. Have a child choose the set which corresponds with the numeral. Have the number of the set identified. Continue the activity. Use three sets with different numbers. Place a numeral on the board which will correspond with one of the sets. Give several children the opportunity to match numerals and sets.



▶ On the chalkboard, draw sets of nine circles. Ask a child to use a piece of colored chalk to show a set within one of the sets of nine. Proceed in this way with the other sets of nine which have been drawn on the board. After all possible subsets have been colored within the sets of nine, discuss each in turn.





▶ Work page K-51 provides children with an additional experience in recognizing sets of nine. Ask some child to tell what numeral he sees in the center of the page. Direct the class to trace the outline of the numeral with their fingers. Review the meaning of nine in terms of the "one-more" concept—nine is the number that is one more than eight.

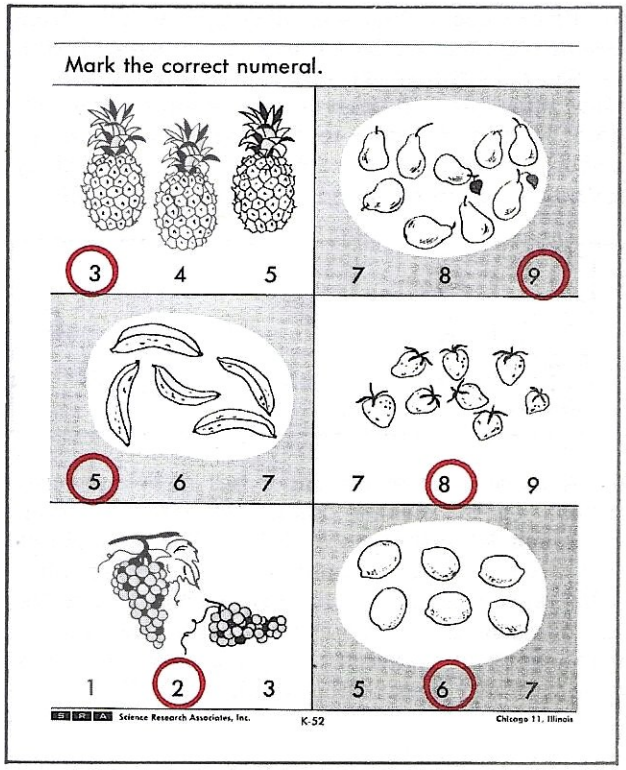
Tell the children to count to find the number of the set of oranges. Have the children mark the set if it contains the number of objects the numeral represents. Direct the group to mark each set of nine on the remainder of the work page.

With work page K-52 explain to the children that they are to mark the numeral, in each box, that stands for the number of the set. Have the children look at the set of pineapples. When they have decided how many pieces of fruit are in the set, they are to mark the correct numeral. Continue in this way for the remainder of the work page. Work with the children as they determine the cardinal number of each set.

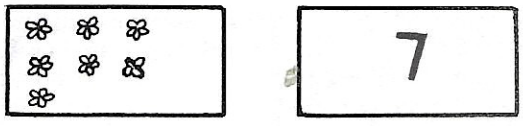
Supplemental Experiences

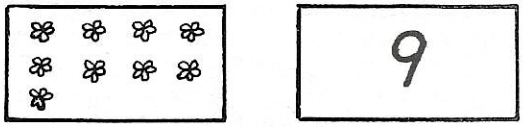
▶ Direct children to listen and count very carefully, to themselves, as you tap a specific number of times on a wood block. Call upon one child to build a set, on the flannel board, which has the same number as the set of taps he just counted. Have another child select the corresponding numeral to place on the board with the set. Repeat the activity several times.

Vary the activity. Give several children in the group set-cards, or cards marked for sets one



through nine, and numeral-cards which are marked 1 through 9. Tell the children that they must examine their cards closely and determine which set or which numeral they hold. Now direct them to close their eyes and listen as you tap a specific number of times on the wood block. Children having the set-card and the numeral-card that match the number of taps heard must come forward and place their cards on the flannel board. Continue the activity as long as the children are interested.





▶ Play a game of "I Spy." Place five or six set-cards on the flannel board. Tell the children that you spy, on the board, a set whose number is one more than six. A child who thinks he has found the set about which you are thinking may describe it. When the set has been identified, begin the game again. The child who identified the last set may be the one to spy the next set. Change set-cards often, so that children must be alert in order to find the correct one.

Numbers and Numerals: 10

Work Pages K-53 and K-54

Objectives

To teach the meaning of the number ten.

To provide practice in recognizing sets containing ten objects.

To help children learn to recognize the numeral 10 and relate it to sets of ten.

To help children begin to see different subsets within a set of ten.

Fundamentals

The kindergarten child will accept the concept of ten as that number which is one more than nine. Thus, the symbol for the number ten is treated just like the other symbols presented up to this time. Since the child is encouraged to think of the numeral 10 merely as the symbol invented to label the set of ten, discussion of place-value concepts should be deferred until later; development of the place-value concept forms a major portion of the work in grade one.

The teacher may choose to develop the children's counting skills beyond ten, but the GCMP will not present any numerals beyond 10 on the kindergarten pages. Symbols for numbers greater than ten will be developed only when it is possible to make it clear to the child just how these symbols relate to the concept of place value.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Sets and One-To-One Correspondence; Numbers and Numerals; Order—Relations—Operations.

Readiness for Understanding

Ability to recognize sets whose numbers are one through nine.

Ability to associate the appropriate numeral with sets whose numbers are one through nine.

Ability to see sets within a given set.

Ability to count to nine.

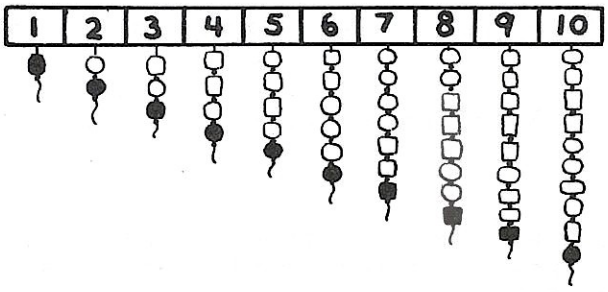
Developmental Experiences

MATERIALS

55 gummed stickers
large piece of construction paper
crayon
wooden beads
string
flannel board
felt numerals 1 through 10
paper fish prepared to adhere to flannel board
set-cards 1 through 10

VOCABULARY

ten

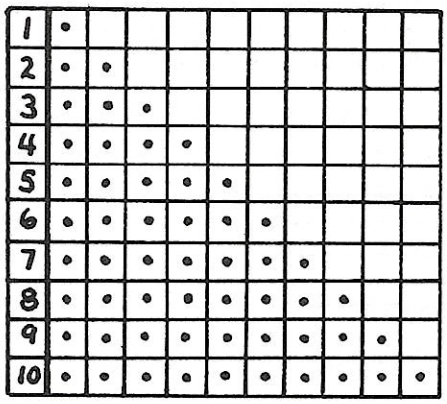


▶ Call the attention of the children to the bulletin board bead display which was begun at the time of work with sets of one and continued as each new set was introduced. Tell the children that the time has come to build the last set in the display, the set that comes after nine. Ask, "What number do you think this last set will have?" Give one child nine beads to put on a string. Help the child tie a knot after each bead as he places it on the string. Ask, "How many more beads are needed to make the new set?" Have the child put the "one-more" bead (of a different color) with the set of nine beads. Guide the class to conclude that *ten* is nine and one more. Place the new set, the set of ten, next to the set of nine, on the bulletin board.

Hold up a felt numeral 10 and say that this is the numeral for the number ten. Place it with the set on the bulletin board.

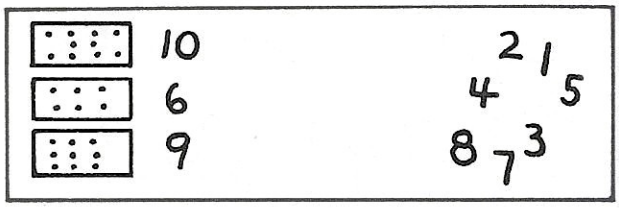
Place another numeral 10 on the flannel board. Call upon several children to build sets that belong with this numeral.

▶ On a large piece of construction paper mark off ten rows and eleven columns. Write the numerals 1 through 10 in the boxes in the first column. Pin this chart to the flannel board. Ask a child to read the first numeral in the column. Have him tell how many of the gummed stickers he thinks should be placed in the first row. Direct him to put the one sticker in the first box next to numeral 1.

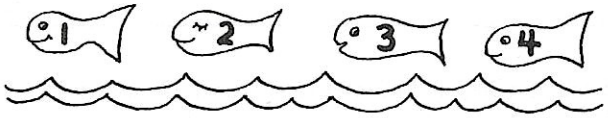


Continue to have the children build the other sets from two through ten. Have the corresponding numeral for the set read each time. Emphasize the "one-more" pattern as each new set is built.

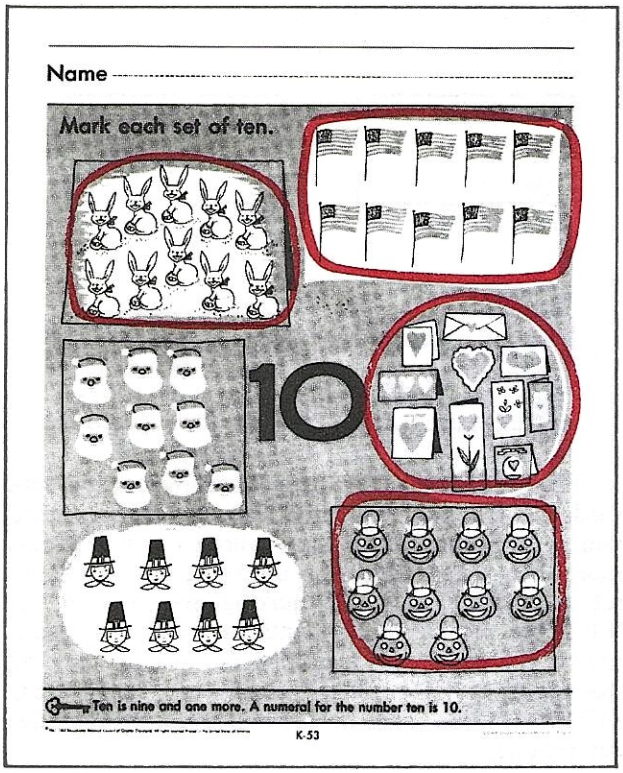
▶ Place three or four sets, ranging in number from five through ten, on the left half of the flannel board. On the right half of the board, in scattered fashion, place numerals 1 through 10. Call upon several children, in turn, to come to the board and place the correct numeral next to each set. Repeat the activity several times, using different set-cards each time.



▶ Arrange a set of ten paper fish in helter-skelter fashion on the flannel board. Have the numerals 1 through 10 written on each fish. Tell the children that the fish were swimming along in order when a big wave scattered them. Ask a child to line the fish up again, in order. Have many different "waves" come along to scatter the fish and each time let a child rearrange them on the board.



▶ Use work page K-53 to give the children additional opportunities to recognize sets of ten. Ask, "Who can read the numeral in the center of the page?" Review the meaning of ten as the number that is one more than nine.



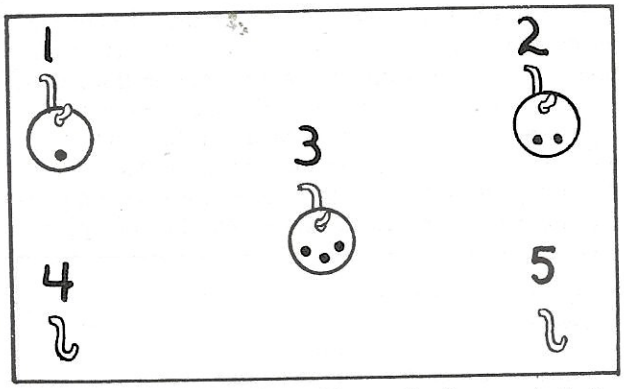
Tell the children that they must find out how many bunnies are in the first set. Direct them to mark the set if it contains the number of objects represented by the numeral. Have the children mark each set of ten on the rest of the page.

Work page K-54 gives the group another experience with sets within sets. Have the children point to the row of Easter baskets. Have one child tell what numeral he sees in this row. Tell the children that they must draw a ring around the number of objects for which the numeral stands. Continue in this way, row-by-row, until the page is completed. Discuss each row with the group. Have them tell what sets they can find within each set of 10.

Supplemental Experiences

▶ Complete the class Number Book. Ask the children to cut out pictures of sets with ten objects in each set and to bring them to class. Discuss the different pictures. Help the children paste their pictures on the correct pages in the book.

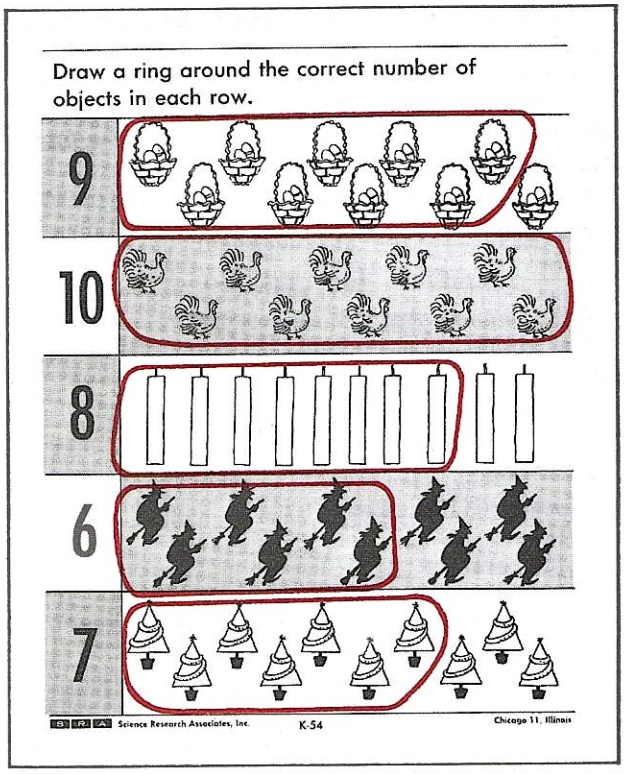
▶ Place five hook screws on a 15″ x 15″ board, one screw in each corner and one in the middle of the board. Tape paper numerals 1 through 5 above each hook. Cut out about thirty tagboard disks 3 inches in diameter. Punch and reinforce a hole in the top of each disk. Construct various dot patterns on the disks to represent sets one through five.



Place the disks in a box. Cover the box and shake it to mix the disks. Have children come to the box and, in turn, choose a disk and place it on the hook under the correct numeral. When all of the disks have been placed correctly, the numerals over the hooks can be changed from 1 through 5 to 6 through 10. Have the children choose and place disks with sets from six through ten pictured on them.

▶ Read stories related to numbers, such as *Count to Ten* by LILIAN MOORE (New York: Golden Press, Inc., 1957); *Count With Me 1-2-3* by CAROL PAASCHE (New York: Golden Press, 1962); *Chicken Little Count-to-Ten* by MARGARET FRISKEY (Chicago: Children's Press, Inc., 1946; and, *Jeanne-Marie Counts Her Sheep* by FRANÇOISE (New York: Charles Scribner's Sons, 1957).

▶ Two songs the children will enjoy while working with sets of ten are the traditional "Ten Little Indians" and "New River Train" from *More Songs to Grow On* (New York: William Morrow & Co., Inc., 1954).



★ More than one correct answer is possible for each problem.

Numbers and Numerals

Comparison: 4 Through 10

Work Pages K-55 and K-56

Objectives

To help children increase their ability to compare pairs of numbers.

To help children extend their understanding of the relationship between two different numbers.

Fundamentals

The kindergarten child was introduced to the concept of comparison in the known environment of geometric shapes. He learned to discriminate between shapes of different sizes and to decide which were larger or smaller or which were the same size.

As he worked with sets and as the "one-more" pattern in the natural order of the whole numbers became evident, he was again exposed to the concept of comparison. The sets were not equivalent. As he compared them, he discovered that the number of one set was greater than or less than the number of another set.

The child is now ready to extend his understanding of this important concept. Although such terms as "comes before" and "comes after" are often used with the kindergarten child at this level of his development, it must be remembered that these terms actually mean "is less than" and "is greater than."

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Order—Relations—Operations.

Readiness for Understanding

An awareness that not all sets are equivalent.

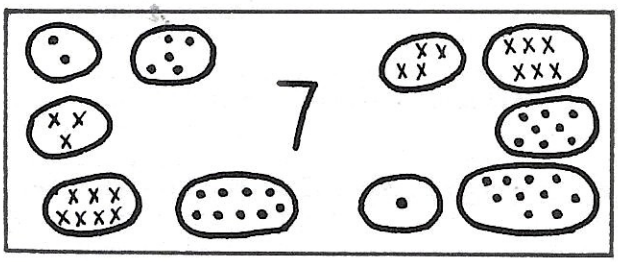
The ability to order numbers from one through ten.

Developmental Experiences

MATERIALS

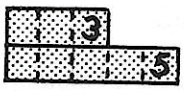
set-cards one through ten
flannel board
felt counters
felt numerals 1 through 10
ten strips of red construction paper
(2″ x 2″, 2″ x 4″, 2″ x 6″, 2″ x 8″, 2″ x 10″, 2″ x 12″, 2″ x 14″, 2″ x 16″, 2″ x 18″, 2″ x 20″)

▶ Have several children build sets whose numbers range from one through ten around the periphery of the flannel board. Place the numeral 7 in the center of the board.



Ask a child to identify a set whose number is greater than the number for which the numeral stands. Ask another child to find a set whose number is less than the number the numeral represents. Continue in this way until the numbers of all the sets have been compared to seven. When seven is compared to seven emphasize that the numbers are the same. Change the numeral and repeat the activity several times.

▶ Mark off each of the ten red construction paper strips into two-inch blocks. Label the 2″ x 2″ strip 1, the 2″ x 4″ strip 2, and so on, placing the numeral at the far right. Place the ten-inch strip and the six-inch strip numeral-side down on the flannel board. Tell the children that one strip stands for the number five and the other stands for the

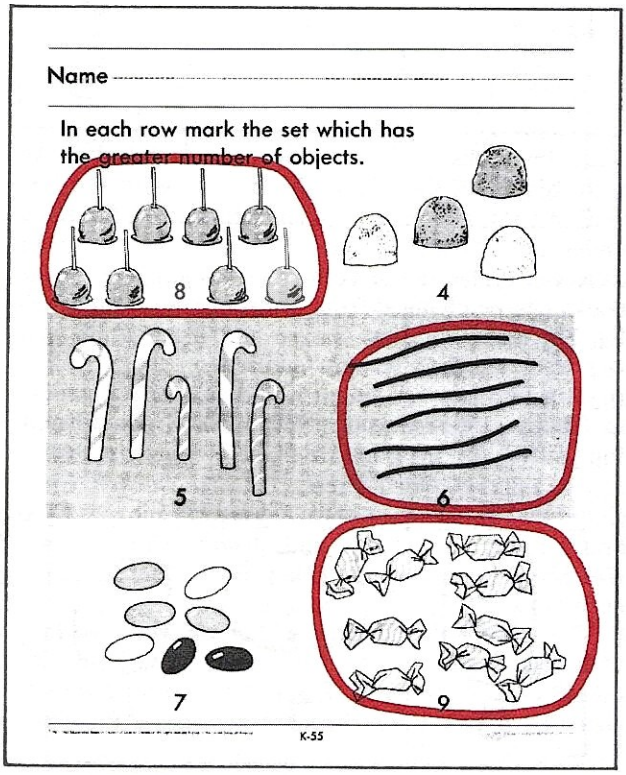


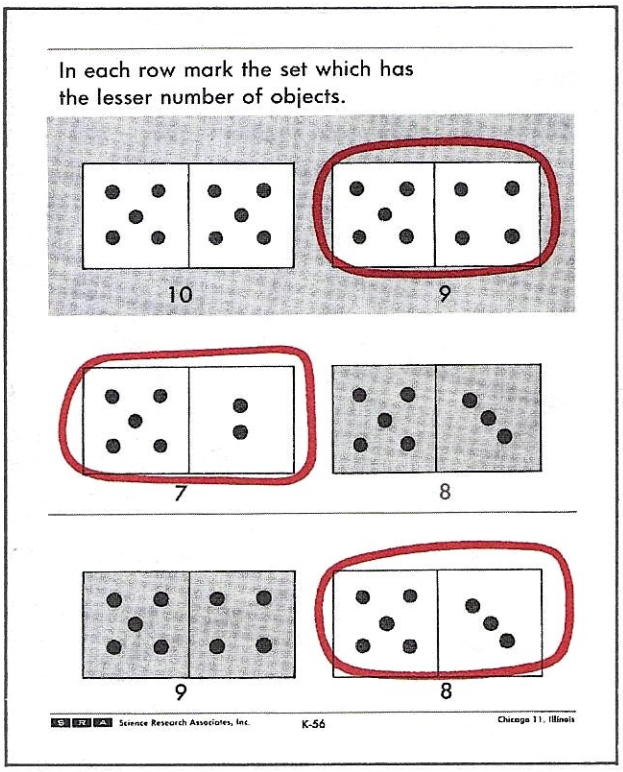
number three. Ask, "Which do you think is the five-strip?" Have the children explain their choice. Turn over both strips and compare them. Have the less mature children match the blocks one-to-one. Continue to compare other strips in this way.

▶ Distribute set-cards, one through ten. Call upon a child to come to the front of the group and hold up his set-card for everyone to see. Have the number of this set identified. Call upon another child. Tell him to compare the number of his set to the number of the first child's set. If the number of his set is greater than the number of the given set, have the child stand to the left of the first child. If the number of his set is less than the number of the given set, have the child stand to the right of the first child. Continue in this way until the numbers of all of the sets on the cards have been compared to the given set. Repeat the activity and use a different set as the given set.

▶ Work page K-55 offers the children an additional opportunity to compare pairs of sets that are not equivalent, and to determine which set has the greater number. Have the children look at the first row of pictures. Ask a child to tell how many candy apples are in the one set. Ask another child to tell how many gumdrops are in the other set. Tell the children that they are to mark the set that has the greater number of objects. Have some child tell what he has discovered about the numbers of the two sets being compared. Have the children examine the sets in the second row. After they determine how many peppermint sticks are in one set and how many licorice sticks are in the other set, direct them to mark the set that has the greater number of objects. Ask someone to tell which number is greater. Encourage the child to use a complete sentence: Six is greater than five. Use the same procedure for the third row.

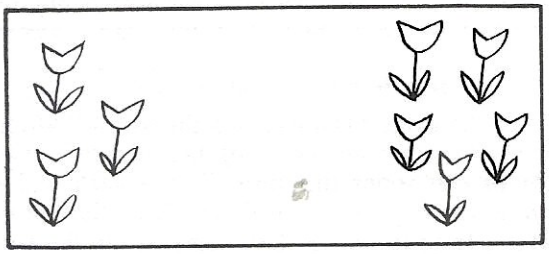
Work page K-56 provides the children with the opportunity to determine which set has the lesser number. Follow the same method suggested for use of work page K-55. On this page, however, emphasize the set which has the lesser number of objects.





Supplemental Experiences

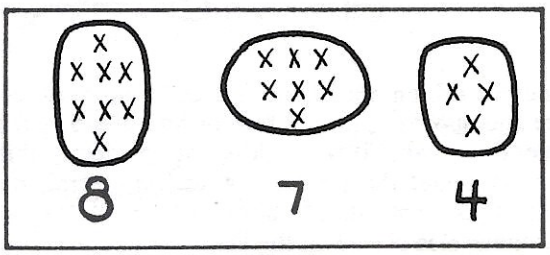
▶ Place a set of ten paper flowers (prepared to adhere to the flannel board) in a little basket. Place a duplicate set of flowers in another little basket. Have a set of flowers selected from each basket and placed on the flannel board.



Ask, "Which set has the greater number?" Have the number of each set named. Have the comparison between the two numbers stated. The children may say, "Five is greater than three," or "Three is less than five."

▶ Place a set of seven objects on the flannel board. Under the set place the numeral 7. Ask a girl to build a set to the left of the given set. Have her place the correct numeral under the set.

Ask a boy to build a set to the right of the given set. Have him place the correct numeral under the set. Have the class compare the numbers of the two new sets in relation to the given set.



Numbers and Numerals: 10

ORDER 1 Through 10

Work Pages K-57 and K-58

Objectives

To re-emphasize the concept of counting.

To re-emphasize the order relation between the numbers one through ten.

Fundamentals

The kindergarten child has had many experiences with the natural order of the set of whole numbers up to this time. Over and over again his teacher has created classroom situations in which the "one-more" pattern, evident in the basic sequence of the natural numbers, has been stressed.

Before the child moves on to explore new territory, one last work page directly treating the concept of order and counting is provided. While new concepts are being developed, many opportunities will arise naturally in the classroom which will permit the child to make direct application of his knowledge of the concepts of order and counting developed in the beginning phases of the story of number.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Order—Relations—Operations.

Readiness for Understanding

The ability to count to ten.

The ability to recognize the numerals 1 through 10.

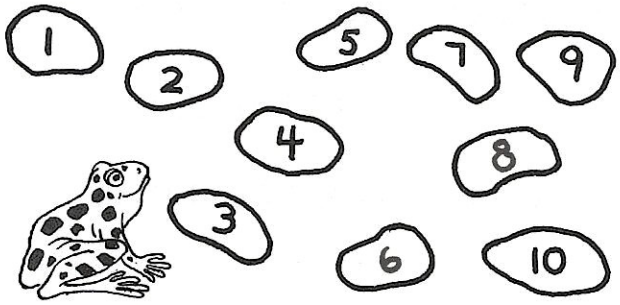
Developmental Experiences

MATERIALS

10 paper "stones" prepared to adhere to flannel board
flannel board
felt frog
felt numerals 1 through 10
tagboard latticework with ten openings
strips of numerals 1 through 10 for each child
scissors
paste

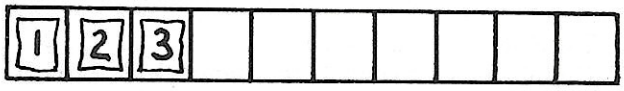
▶ In random manner on the flannel board, place ten paper "stones" on which the numerals 1 through 10 have been written.

Give a child in the group a felt-cutout frog. Tell the child that he must help the frog jump across the brook. The frog must jump on each stone, in order, beginning with 1, to reach his destination on the other side of the brook.

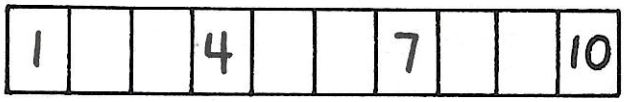


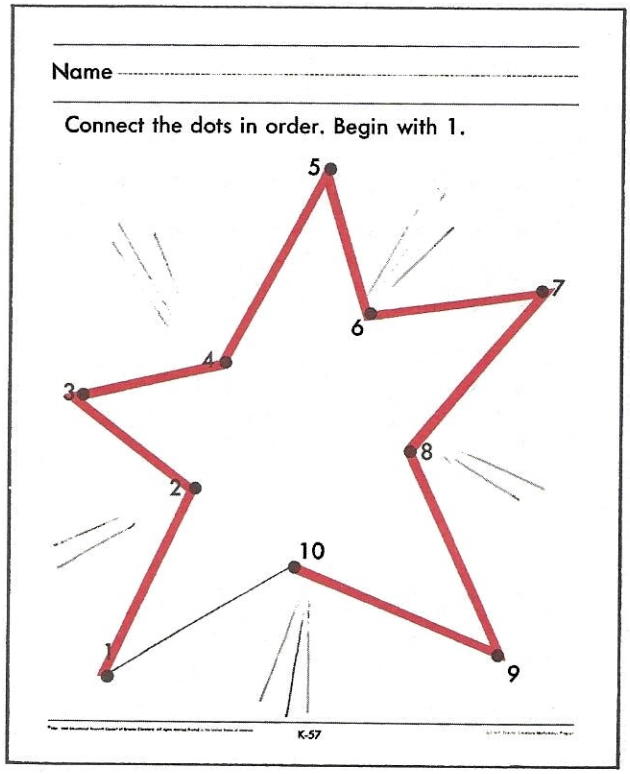
When one child has had the opportunity to help the frog cross the brook, change the order of the "stones" and call upon another child to be the frog's helper. Continue in this way to give several children a chance to utilize their knowledge of the natural order of whole numbers.

▶ Provide each child in the class with a strip of paper on which the numerals 1 through 10 have been written, in random fashion. Distribute sheets of paper which have been marked off into ten squares, to each child. Direct the children to cut the numeral 1 from their strips of numerals and paste it in the first box on their large papers. Ask which number is one more than one. Tell the children to cut the numeral for this number and paste it next to the 1. Continue in this way until the children have cut and pasted all of their numerals in order from 1 through 10.



▶ On the flannel board, place a strip of tagboard latticework. Distribute felt numerals 1 through 10 to ten children in the group. Call upon these children, by name and at random, to come to the flannel board and place their numerals in the appropriate opening in the latticework. Explain that the numerals must be in order, left to right from 1 through 10, when the activity is completed. Repeat the activity several times.

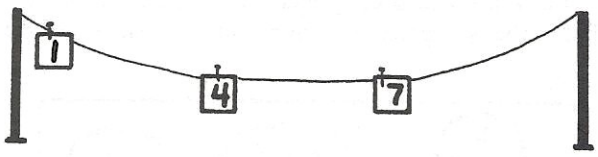




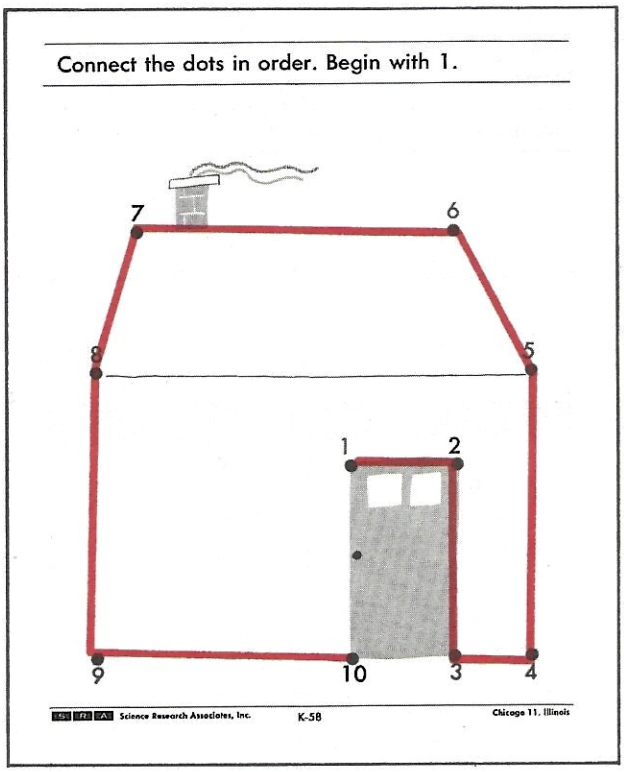
▶ Use work pages K-57 and K-58 to provide additional opportunities for the children to work with numbers in their natural order. Tell the children to place their crayons on the numeral for the number they use to begin counting. Have this numeral identified. Direct the children to find the numeral for the number which comes after one. Tell them to draw a line to connect 1 and 2. Encourage the children to complete the dot pictures on their own from this point on. Give help only when and where needed.

Supplemental Experiences

▶ Play the game "Hanging Up the Wash." Stretch a piece of heavy yarn or string between two heavy pieces of classroom furniture. Fasten each end of the yarn securely to the furniture. Place the "pieces of wash" (numeral-cards 1 through 10) in the wash tub (large cardboard box). Have some child come to the front of the room and pretend to scrub the clothes (go through the scrubbing motions in the box). This same child may call upon helpers to assist him in "hanging the wash." Each child called upon will take a small clothespin and hang his



numeral-card on the line. The children must estimate the approximate position on the line that their numeral will take. If the children are guided to think carefully about the position of their numeral, only slight adjustments should have to be made as each new numeral is placed on the line.



▶ Punch two holes along the top edge of large numeral-cards 1 through 10. Thread a 20″-piece of yarn through the holes and tie the ends of the yarn together. Hang one card around the neck of each of ten children. Have the children sit on the floor in a large circle formation in random order. Give a large ball to the child who has the numeral 1. Tell the children that they are to roll the ball, in turn, to the child who has the next numeral after their numeral. When the child with the numeral-card 10 has the ball, have the children that were chosen give their cards to ten other children and begin the game again.

Number Combinations of Two and of Three

Work Pages K-59 and K-60

Objectives

To strengthen number concepts.

To lay the foundation for the development of the concept of addition.

Fundamentals

The five-year-old child has had the experience of looking for sets within a given set. He has had his thoughts stirred in the direction of thinking of pairs of disjoint sets contained within a given set. His work with sets now will be extended to include an operation on pairs of sets. He will discover that a new set is formed when one set is joined to another set. His excitement about numbers will increase when he discovers that the new set contains both of the sets he joined, that they make up the new set. This is something with which he is already familiar—sets within a set. The child's understanding of this operation of union of sets will form the foundation on which the development of the concept of addition of numbers will be based. *(Only disjoint pairs of sets*—sets which have no elements in common—will be considered in this development.)

As an introduction to the idea of addition, the child will be asked to determine the cardinal number of each of two sets. He will then join one of the sets to the other set to form a new set. Finally, the number of the new set—the number of the union of the two sets—will be determined. At a later stage in the development of the concept of addition the child will learn to call this number the "sum" of the numbers of the two given sets.

Care must be taken to use precise language so that the concepts of union of sets and addition do not become confused in the mind of the child. When dealing with union of sets, the term "join" is appropriate. "Add" and "plus" must be reserved for work with numbers. Avoid speaking about "adding sets." Instead talk about "joining sets." Never use a plus sign between pictures of sets.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Sets and One-To-One Correspondence; Addition of Whole Numbers.

Readiness for Understanding

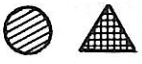
Ability to determine the number of a set.

Developmental Experiences

MATERIALS	VOCABULARY
flannel board	join
felt cutouts	put together
large piece of construction paper	plus
crayons	

▶ On the flannel board, arrange two sets, each containing one object. Have the children determine the number of each set.

Now bring the set on the right close to the set on the left. Say, "A set of one has been *joined* to another set of one to make a set of two."

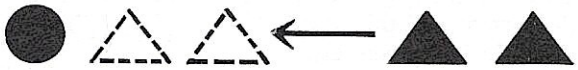


Discuss with the children the new set that has been formed. Help them determine the number of the new set—the number of the union of the two

sets. Say, "A set of one and a set of one can be *put together* to make a set of two." Explain to the children that another way to tell the story or describe what happened is to use only the numbers of the sets and say, "One *plus* one is two." Lead the children to visualize the original sets as subsets of the new set. Say, "A set of two contains a set of one and a set of one."

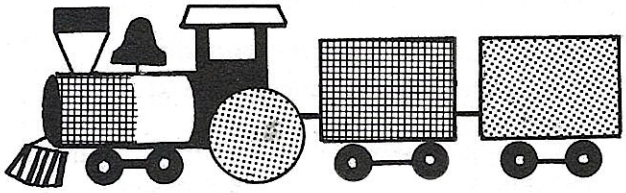
Repeat the activity but use sets of two and one, in that order. Call upon someone to explain what happens when a set of one is joined to a set of two: namely, that a new set of three is formed. Have another child use only the numbers of the sets to describe the combinations involved. He can say, "Two plus one is three."

Continue the development of the concepts of set union and addition but now use sets of one and two, in that order. Make no attempt to formalize addition combinations at this point in the development.

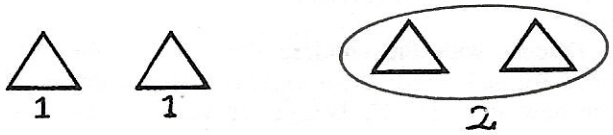


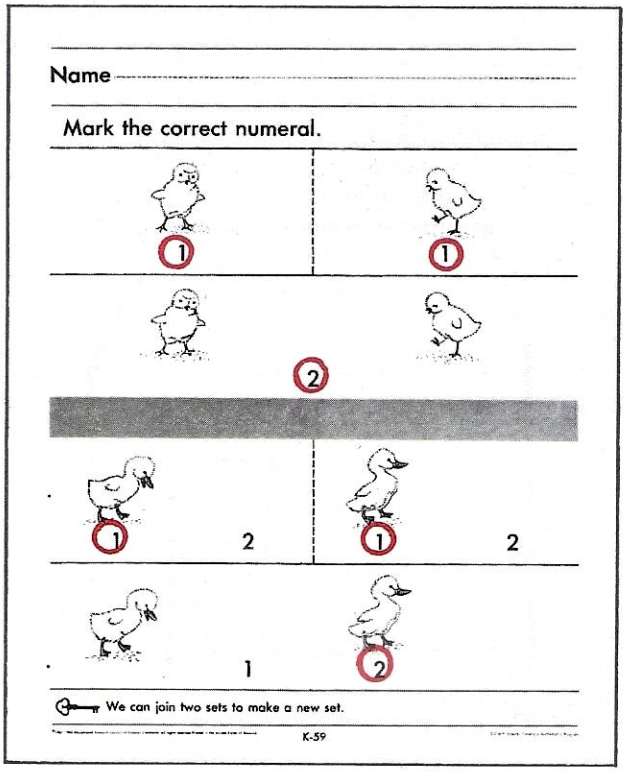
Do not write equations, but simply have children verbalize about the ideas involved with sets and with the numbers of the sets.

▶ Vary the activity by working with sets of toys. Hold up a toy engine. To it join a set of two railroad cars. Have the children tell how many parts are in the train. Encourage those children who are able to do so to tell the complete story of the union of these sets.

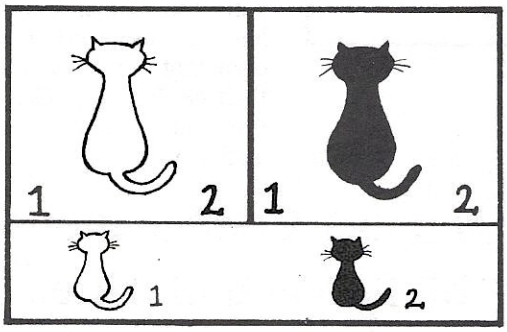


▶ On the chalkboard, draw a set containing one triangle. Have the children give the number of the set. Write the numeral 1 beneath the set. Next to this set draw another set of one triangle. After the children tell the number of the second set, label it also with numeral 1. Draw a ring around the two sets. Tell the children that the ring is there to help them think about the joining of the sets. Have the children name the number of the new set. Erase the 1's and write the numeral 2. Have the children explain what happened: the set of one and the set of one were joined to make a set of two.





▶ Work page K-59 provides children with the opportunity to work with the number combinations of two. To orient the children to K-59, draw a sample problem on a large piece of paper and present it to the group. Have the children examine the two sets and give the number of each. Direct two of the children to mark the correct numerals in each box. Tell the group to think about joining these two sets. Ask them to picture in their minds how the new set will look. Reproduce the two cats in the empty space at the bottom of the sheet. Write the numerals 1 and 2 below the cats. Have the children give the number of this new set. Ask one of them to mark the correct numeral.



Have the children fold work page K-59 in half so that only the upper section of the page is in view. Direct their attention to the top part of this paper. Discuss the first two sets. Help the children see that there is one chick in each set and that the numeral 1 names the number of each set. Now help them think of the two sets as a single set when they look at the second row. Discuss the number of this new set and the numeral 2.

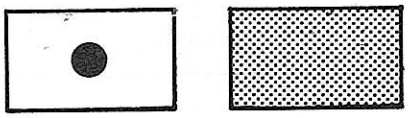
Direct the children to turn their papers over so that the bottom half of the page is exposed. Discuss each set in the first row. Tell the children to choose the one correct numeral each time and mark it. Have them look at the next row and mark the one numeral which names the number of the new set—the number of the union of the two sets.

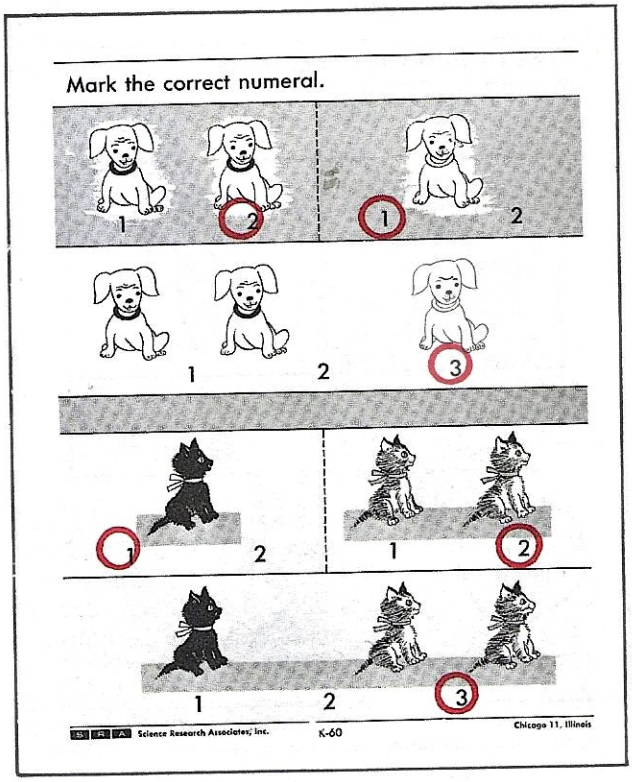
Follow a similar procedure when using work page K-60 This work page provides children with an additional experience using combinations of three. Help the children verbalize about the joining of the two sets to make a new set. If some children wish to tell the story about the sets and use only the numbers of the sets, encourage them to do so.

Supplemental Experiences

▶ Place one bead on a piece of string or wire. Have a child place another bead of a different color next to the first bead. Call upon someone in the group to tell a story—first in terms of sets and then using only the numbers of the sets—to describe what happened. Be extremely careful to use the appropriate terms when talking about sets and when talking about numbers. Continue the activity and use other known combinations—one and two, two and one.

▶ Place two set-cards, face down and close together, on the flannel board. Turn the cards over, one at a time. Have a child tell the story of the union of the two sets.





Number Combinations of Two and of Three

Work Pages K-61 and K-62

Objectives

To help children recognize number combinations of two and of three.

To develop, in an informal way, the concept of commutativity of addition.

To re-emphasize the known concept of sets within a set.

Fundamentals

The kindergarten child has just embarked upon a new venture. Another facet in the development of whole numbers has been presented for his study. The teacher has involved him in learning situations which have aroused his interest in one of the operations with sets, union, out of which emerges one of the basic operations with whole numbers—addition.

The child is now on the threshold of making a new discovery. The concept of commutativity of addition will be informally examined. The activities in the preceding lesson laid the groundwork for discovery of this concept. The child may already have an inkling of the idea. He may be vaguely aware that the order in which he joined two sets did not alter the cardinal number of the union of the sets. Nevertheless, the teacher must now be prepared to begin to intrigue him with a series of seeming coincidences.

A set of two will be joined to a set of one. A new set of three will be formed. A set of one will be joined to a set of two. Again a new set of three will be formed. Is this just a coincidence? It is only as the child has the opportunity to try out this newly discovered possibility with other combinations of sets that he will be truly convinced that such is not the case. At this point, his grasp of the concept will not be firm. Not enough evidence is available. This is only the beginning.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Sets and One-To-One Correspondence; Addition of Whole Numbers.

Readiness for Understanding

The ability to join two sets to form a new set.

The ability to determine the cardinal number of the union of sets.

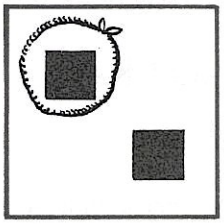
The ability to visualize sets within a given set.

Developmental Experiences

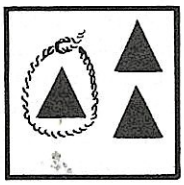
MATERIALS

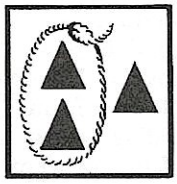
flannel board
felt cutouts
string or yarn
large domino cards

▶ Place a set of two objects on the flannel board. Have the children tell how many objects are in the set. Have one child put a piece of string or yarn around one of the objects in the set. Tell the children that this visual clue will help them think about the pair of distinct sets contained in the set of two. Say that they can think of the circled set as the first set in the ordered pair of joined sets. Call upon some child to explain the situation. He should be able to say that the uncircled object (one square) was joined to the circled object (one square) to make this set of two.



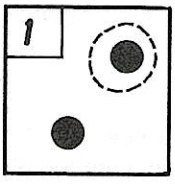
Remove the set of two from the flannel board and replace it with two sets of three. Have a child put a piece of yarn around one of the objects in the first set of three. The child may explain how the two sets within the given set were joined. Have a second child put a piece of yarn around two of the objects in the second set of three. Have this child use the clues he now has and tell how his set was formed.

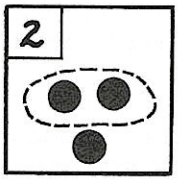


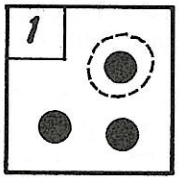


Ask the group if they notice anything interesting about the way each of the sets of three was formed. Guide the children to observe that the number of the union of the first two sets is the same as the number of the union of the second two sets, that a set of two joined to a set of one forms a set of three and a set of one joined to a set of two gives the same result.

▶ Draw one set of two and two sets of three on the chalkboard. Write the numeral 1 or 2 with each set. Have a child point to the set of two. Tell him to draw a ring around the number of objects, within the set, that he thinks of when he sees the numeral that is with the set. Continue in this way with the next two sets.

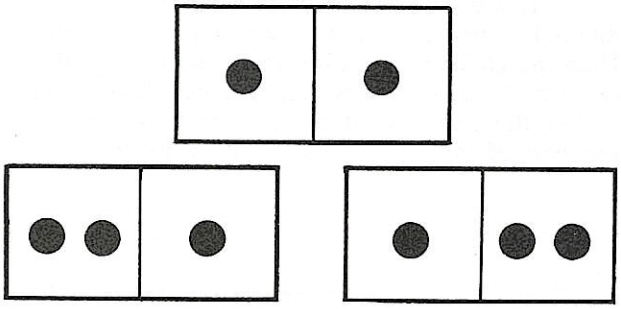




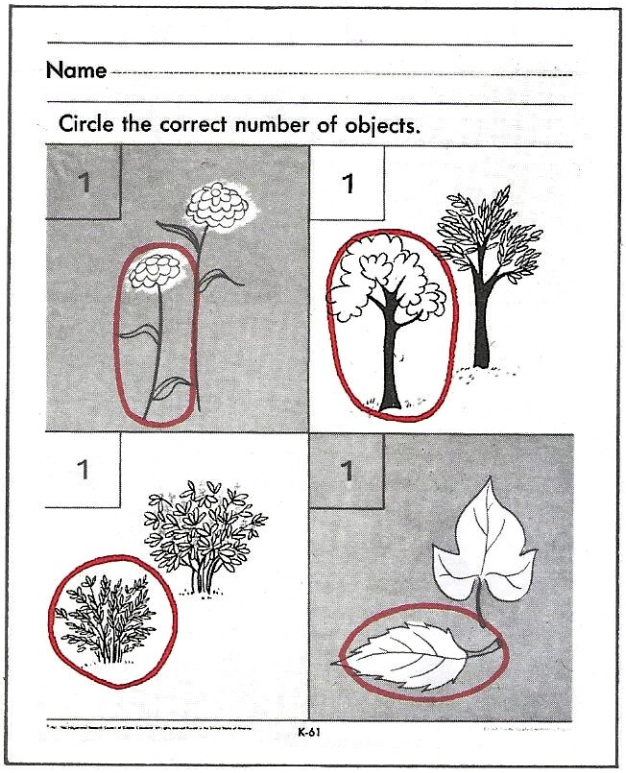


Have the sets within each set discussed. Call upon different children to explain how each set was formed. Perhaps some children will wish to tell the number combinations they think of as they look at each set: one plus one is two, two plus one is three, and one plus two is three. Keep the children aware of the fact that two plus one is three, just as one plus two is three.

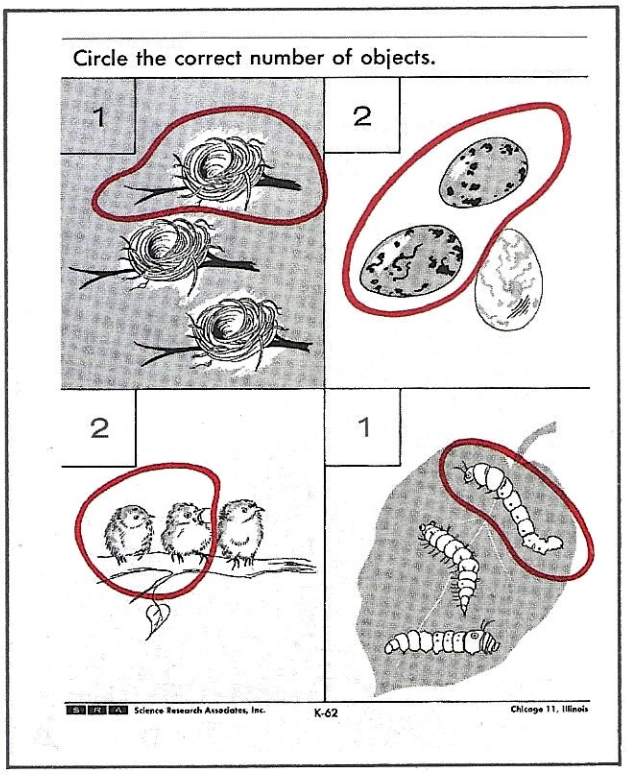
▶ Make large dominoes out of cardboard. Place dots on the dominoes to represent the number combinations of two and of three. Hold up each domino, in turn, and ask the children to tell which sets were put together to make the new set. Have them "read" the domino from left to right. Ask the children to tell which number combination is represented by the dots on the domino.



▶ Work page K-61 can be used to provide children with an additional opportunity to visualize the sets used to form the given set of two. Direct the children to locate the set of flowers on the page. Ask one child to read the numeral in the box with the flowers. Explain to the children that they must circle the number of flowers the numeral makes them think about. Continue in this way with the other sets on the page. When the children have completed their work on this page, discuss each set. Perhaps the children will enjoy telling stories about the sets. Someone may create a story about the flowers. "In my garden I planted one red flower and one yellow flower. I have two flowers in my garden."



★ More than one correct answer is possible for each problem.

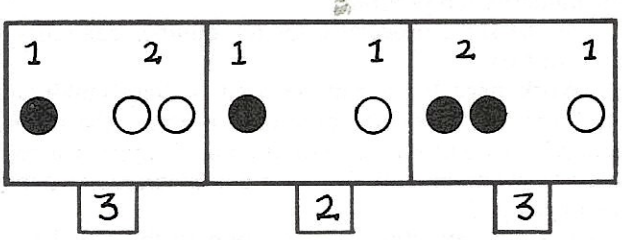


★ More than one correct answer is possible for each problem.

The same procedure can be used to direct the work on work page K-62. Here the children will have another chance to reinforce their understanding of number combinations relating to sets of three. They can be guided to think informally about the commutative property of addition.

Supplemental Experience

▶ On the chalkboard, mark off three large areas in the manner illustrated. Use two different-colored pieces of chalk to draw two sets of three and one set of two. Direct the children to look at the first set.

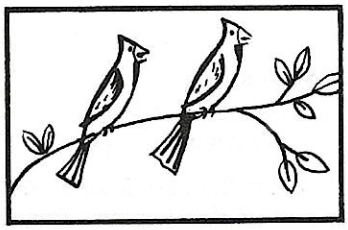


Call upon one child to tell a story about the sets in this first picture. Have him point to the pair of sets within the given set as he explains how a set of two was joined to a set of one to form the set of three. Have him place the related felt numerals above each set that he refers to within the given set. Direct him to put a felt numeral, for the number of the set formed when the two sets were joined, in the section marked off below the set.

Have some other child tell which combination he thinks of as he looks at this first set. Tell him to point to the numerals as he tells the class about this number combination: one plus two is three. Use the same procedure with the other sets.

Present a series of picture cards to the group. Call upon several children to create story problems related to the pictures. The other children must give the answer to the problem. One child may say: "Mary had a scoop of chocolate ice cream and two scoops of vanilla ice cream. How many scoops of ice cream did she have on her cone?"

Another child may say: "One bird sat in the tree. One more bird joined him. How many birds are in the tree?"



Numbers and Combinations of Two and of Three

Work Pages K-63 and K-64

Objectives

To introduce, in an informal and indirect way, the concept of subtraction.

To introduce, in an informal way, the concept of zero.

Fundamentals

The teacher will note an important difference in the approach to combinations on work pages K-63 and K-64. On the four preceding work pages, the child was asked to think in terms of putting sets together or in terms of joining sets. He will now be given a set and a number. His problem will be to decide how many more objects to put with the set so that the number of the new set that is formed is the given number.

The chief point of emphasis will still be on addition combinations. There will be, however, an important side benefit for the child when he works problems of this new type. He will be exposed in an indirect manner to the concept of subtraction.

One other new idea is introduced at this time in the program: the concept of zero. Because the maturity level of the five-year-old discourages any formal presentation of the concept, the teacher exposes the child to the cardinal number of the empty set in a casual way, as situations concerning the empty set arise naturally. When the child discovers

that there are no elements in a set the teacher says simply that there are zero objects in the set. When the child discovers that he needs no more objects to make a total of two objects, the teacher again simply explains that zero objects are needed.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Addition of Whole Numbers; Subtraction of Whole Numbers.

Readiness for Understanding

The ability to join two sets to form a new set.

The ability to determine the cardinal number of the union of sets.

Developmental Experiences

MATERIALS	VOCABULARY
flannel board	how many more
construction paper	zero

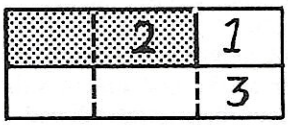
▶ Draw the outline of a domino on the chalkboard. In half of the domino, draw one dot. Write the numeral 2 under the domino and have the children identify it. Ask them to tell *how many more* dots must be drawn on the domino so that there will be two altogether. Call upon one child to draw the one dot in the empty half of the domino. Have another child explain the situation, illustrated on the chalkboard, in terms of sets. He may say that a set of one was joined to a set of one to make a set of two. Have some other child tell what number combination he thinks about when he looks at the sets on the chalkboard. He should say that one plus one is two. Now draw a domino with two dots in one half. Ask the children to tell how many more dots are needed to make a total of two dots. Say that *zero* dots are needed in this half of the domino.

Continue in the same way to develop the combinations of three.

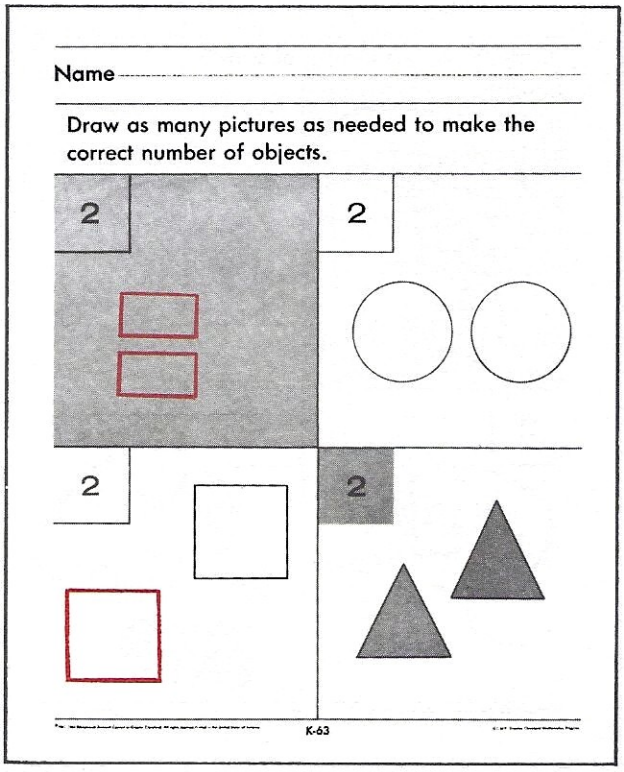
▶ Cut a 12″ x 2″ strip of red construction paper into one 6″, one 4″, and one 2″ strips. Mark off the strips into 2″ blocks. Label each strip in the manner illustrated. Construct a similar set of green strips. Prepare all strips to adhere to the flannel board.

Place them in scatter fashion on the side of the flannel board. Put a two-strip in the center of the board. Ask the children to tell how many more blocks are needed with two to make three. Have one child place the one-strip next to the two-strip.

Call upon another child to find a single strip that has the same number of blocks as the pair of strips. Have him place this strip directly under the other two strips. Say that two plus one is three.



Now set the stage in such a way that the commutative property of addition will be obvious. Remove the three-strip from the flannel board. Place the one-strip under the two-strip on the board. Call upon a child to find the strip needed with the one-strip to make three. Have him place this strip next to the one-strip. Ask another child to tell two set-stories related to the illustration on the board. He should say that a set of one joined to a set of two makes a set of three; that a set of two joined to a set of one also makes a set of three.



Some other child may tell about the number combinations he sees represented on the flannel board: two plus one is three, one plus two is three.

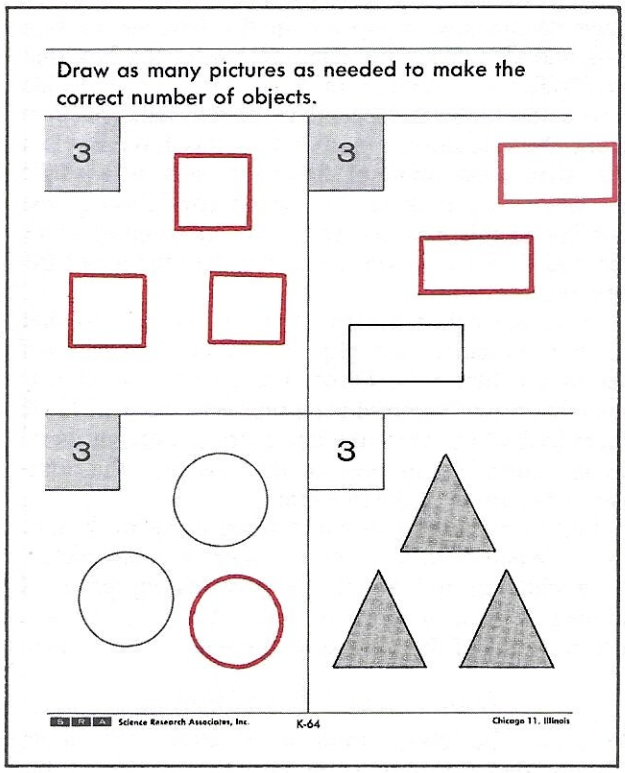
Place the three-strip directly under the others on the board. Ask the children to tell how many more are needed with this strip to make three. At this time simply say that three plus zero is three. No further explanation is needed. Only an informal exposure to the concept of zero should be presented in the kindergarten program.

Use the same procedure for the number combinations of two.

▶ Work page K-63 can be used to help children reinforce their understanding of two ideas: the concept of zero and the "how-many-more" approach to addition combinations. Number combinations of two are developed.

Direct the attention of the group to the first box on the page. Tell the children to look at the numeral in this box. Have a child tell how many pictures he sees. Direct the children to think how many more pictures are needed to make the correct number of pictures. Say that they must draw this many pictures. Continue in this manner with the other sets on the page. When the work is completed, have the children discuss the number combinations related to the pictures.

Work page K-64 develops the number combinations of three. Follow the same procedure suggested for work page K-63 when presenting the page.



Supplemental Experiences

▶ Place one bead on a heavy wire or string. Have a child tell how many more beads must be placed on the wire in order to make a set of two. Have the child place a bead of another color next to the first bead. Ask someone to tell the set story. Ask someone else to tell the number-combination story. Continue the activity. Build the number combinations of three.

▶ Play the game "Gatherings Eggs." Place one clay egg in a little basket. Place four more clay eggs on a table. Give the basket to a child and tell him that he must gather as many more eggs as he needs to make two. Other children may be given different problems to solve.

Vary the activity. Instead of telling each child the total number of eggs he must gather, ask him to read a numeral on the flannel board to find out.

Each time the eggs are gathered, have the children tell the set story and the number-combination story involved.

Number Combinations of Four

Work Pages K-65 and K-66

Objectives

To extend the understanding of the union of sets.

To extend the understanding of the concept of addition to number combinations of four.

Fundamentals

The child will now be called upon to apply, in a new environment, his understanding of the joining of two sets to make a new set. The cardinal number of the union of the sets will now be four.

The teacher need not formalize any of the addition concepts by writing equations or by writing the problem in any other formal way. The child is not expected to master the combinations at this time. At the kindergarten level, he is only beginning his work with the addition concept, and the teacher need not expect memorization of the facts.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Sets and One-To-One Correspondence; Addition of Whole Numbers.

Readiness for Understanding

The ability to join two sets to make a new set of two or of three objects.

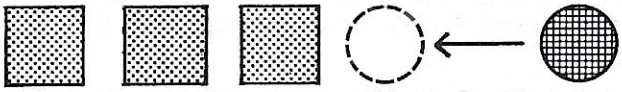
The ability to recognize a set of four objects.

Developmental Experiences

MATERIALS

flannel board
felt cutouts
six clip-type clothespins (3 of one color, 3 of another color)
large piece of cardboard

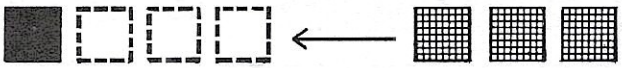
▶ Arrange a set of three and a set of one, in that order, on the flannel board. Have a child join the set of one to the set of three. Tell him to explain what happens when he does this. He should say that



when he puts the set of one with the set of three he gets a set of four. Help the children visualize the original sets as subsets of the new set. Say, "A set of four contains a set of three and a set of one." Ask if anyone thinks he can tell what number combination the set picture suggests. Some child may tell the class that three plus one is four.

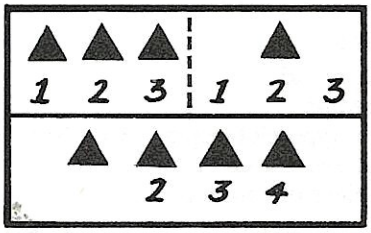
Repeat the activity, but this time use sets of two and two. Call upon one child to tell the others in the group what he thinks happens when a set of two is joined to a set of two: a new set of four is formed. Have another child use only the numbers of the sets to describe the combination involved in this situation. He can say, "Two plus two is four."

Continue the development of the concepts of set union and addition. Now use sets of one and three, in that order. After the manipulation of the objects, have one child describe the activity in terms of the joining of the sets. Ask another child to tell which two sets he sees in the new set. Have a third child give the number combination he thinks of in this setting.



▶ Vary the activity. Clip two red clothespins on a heavy piece of cardboard. Have a child put two green pins with the two red pins. Have the class tell how many pins are now on the card. Ask the child to describe what happened as the sets were joined. Another child may give the related number combination. Continue in this way with other combinations of four.

▶ On the chalkboard draw a set of three triangles and a set of one triangle. Below each set write the numerals 1, 2, and 3. Have the children examine the two sets and give the number of each. Direct two of the children to mark the correct numerals in each box. Tell the group to think about joining the two sets. Ask them to visualize how the new set will look. Call upon one child to draw the new set which will be formed when the two sets are joined. Have him do his work directly under the two given sets. Write the numerals 2, 3, and 4 below the new set. Have the children give the number of this new set. Ask one of them to mark the correct numeral.



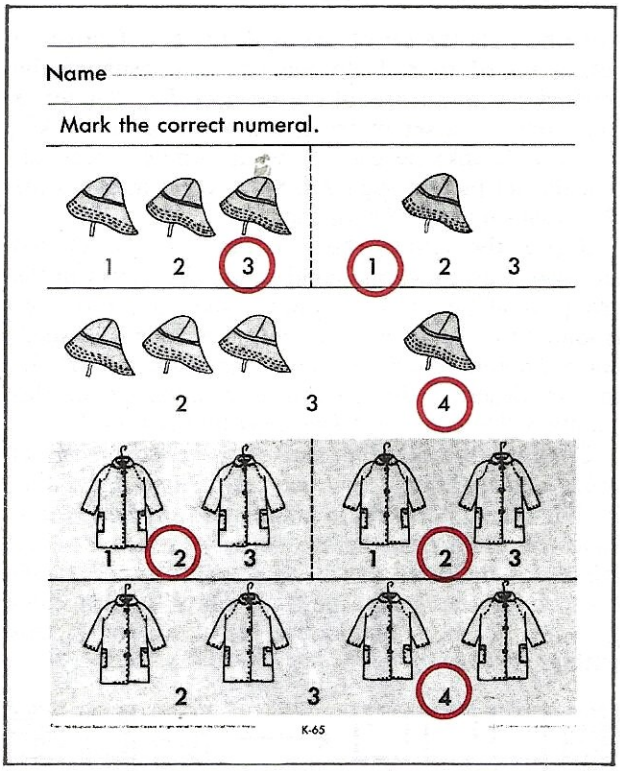
▶ Use work page K-65 to provide the children with another experience in the joining of sets. Direct the children to fold the work page so that only the upper section of the page is in view. Tell them to look at the two sets near the top of the paper. Say that they must decide how many are in the first set of rain hats and then mark the one numeral in the box that stands for the number of hats. They must decide how many are in the second set of rain hats and then mark the one correct numeral in this box. Explain that they must think of these two sets as a single set when they look at the second row. Discuss the number of this new set. Direct the children to mark the one numeral which stands for the number of the new set.

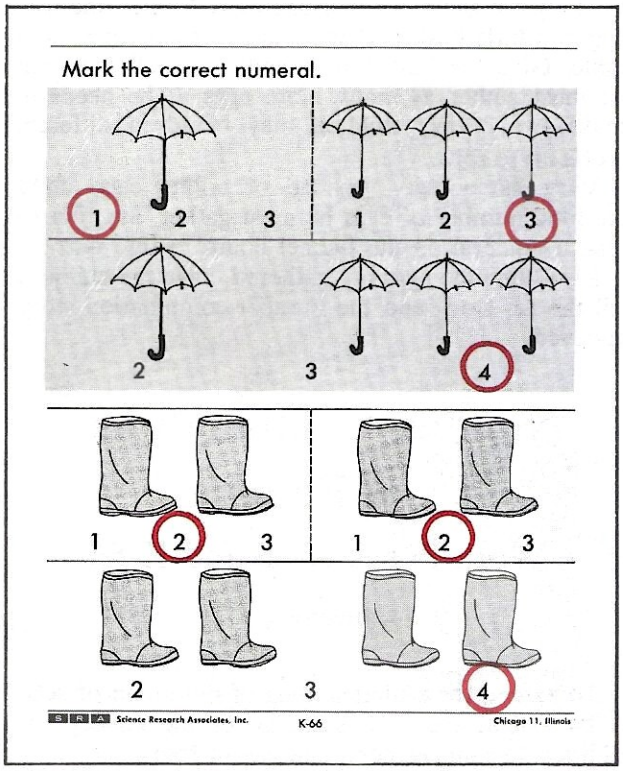
Have the children turn their papers over so that the bottom half of the page is exposed. Discuss each set in the first row. Direct the children to choose the one correct numeral each time and mark it. Have them look at the next row and mark the one numeral which names the number of the new set—the number of the union of the two sets.

Follow a similar procedure when using work page K-66. When both sides of the sheet are completed, have children tell about the pictures in terms of joining of sets, in terms of sets within the new set, and in terms of the number combinations developed.

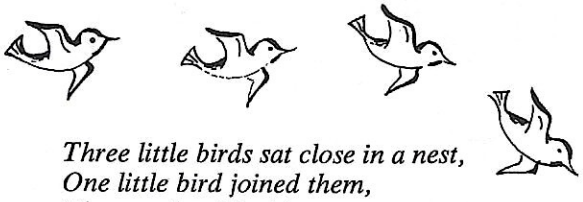
Supplemental Experiences

▶ Have the class stand in a circle formation. Choose two children to go into the middle of the circle and give each of them a rubber ball. Whisper to one child to bounce his ball two times. Whisper to the other child to bounce his ball once. The children forming the circle must tell how many times the two balls were bounced. They must tell the number combination involved. Tell the two children to choose two other children to bounce the balls and continue the game.





▶ Lay a collection of six felt-cutout birds on a table next to the flannel board. Make up a story about the different activities of the birds. As the story unfolds call upon different children to place appropriate sets of birds on the board. Have each phase of the story explained in terms of the joining of the sets, in terms of sets within the new set, and in terms of number combinations.



Three little birds sat close in a nest,
One little bird joined them,
The one they liked best.

Two little birds flew up toward the sun,
Two flew to join them,
They all did have fun!

One little bird hopped over the floor,
Three hopped beside him,
And then there were ____ .

The children may also enjoy making up their own phases of the story about the birds.

Combinations of Four

Work Pages K-67 and K-68

Objectives

To help children recognize the number combinations of four.

To continue to develop, in an informal way, the concept of commutativity of addition.

To re-emphasize the known concept of sets within a set.

Fundamentals

The kindergarten child continues to be given every opportunity to grow more keenly aware of one of the fundamental properties of addition—the commutative or order property. His teacher is alert to design situations which involve the use of this principle. As he advances in his understanding of whole numbers, the advantages of this property of addition will become ever more evident.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Sets and One-To-One Correspondence; Addition of Whole Numbers.

Readiness for Understanding

The ability to join two sets to form a new set.

The ability to determine the cardinal number of the union of sets.

The ability to visualize sets within a given set.

Developmental Experiences

MATERIALS

2 large pieces of modeling clay
8 large wooden pegs
one 2″ hoop
one 4″ hoop
flannel board
felt numerals 1 through 3
felt cutouts
yarn
large piece of construction paper
crayons

VOCABULARY

order

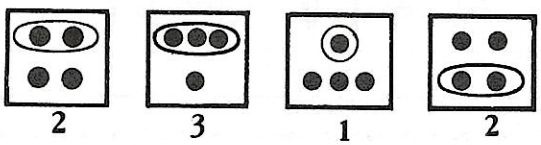
▶ Mount four large wooden pegs in a row in each of two pieces of modeling clay. Display one of the sets of pegs. Have the children tell how many pegs are in the set. Have one child place the larger hoop around the first three of the objects in the set. Tell the children that this visual clue will help them think about the two distinct sets contained in the set of four. Say that they can think of the circled set as the first of the joined sets. With this information, they should be able to tell the class which sets were joined to make the set of four. Ask a child to tell the number combination he thinks about when he sees the set: three plus one is four.

Display the other set of four pegs. Have the children tell how many objects are in this set. Ask one child to place the smaller hoop around the first object in the set. Tell the children that they must explain how this set of four was formed. Again remind the children to think of the objects in the set from left to right. Ask the children what sets they see within the given set. With these facts, the class should be able to tell that a set of three was joined to a set of one to form a set of four. Have some child give the related number combination: one plus three is four.

Ask the class if they discovered anything interesting about the way each set of four was formed. Guide the children to observe that a set of three and a set of one can be found in each set of four. The only difference is the *order* in which the sets were joined to make the new set. The number of objects in the new set is the same.

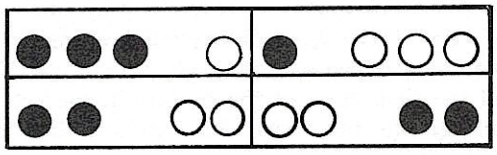
Continue in this manner to develop the number combination two plus two.

▶ Place four sets of four on the flannel board. Place the numeral 1, 2, or 3 under the sets. Have a child point to the first set of four. Tell him to place a piece of yarn around the number of objects within the sets that he thinks of when he sees the numeral under the set. Continue in this way with the next three sets.

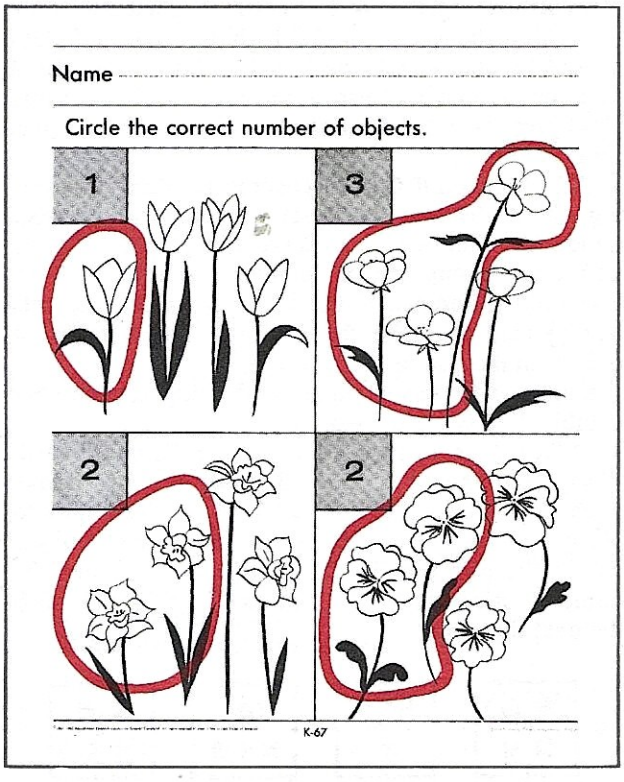


Have the sets within each set discussed. Call upon different children to explain how the sets were joined. Perhaps some children will volunteer to tell about the number combinations represented in each set: two plus two, three plus one, one plus three. Keep the children aware of the fact that three plus one is four, just as one plus three is four.

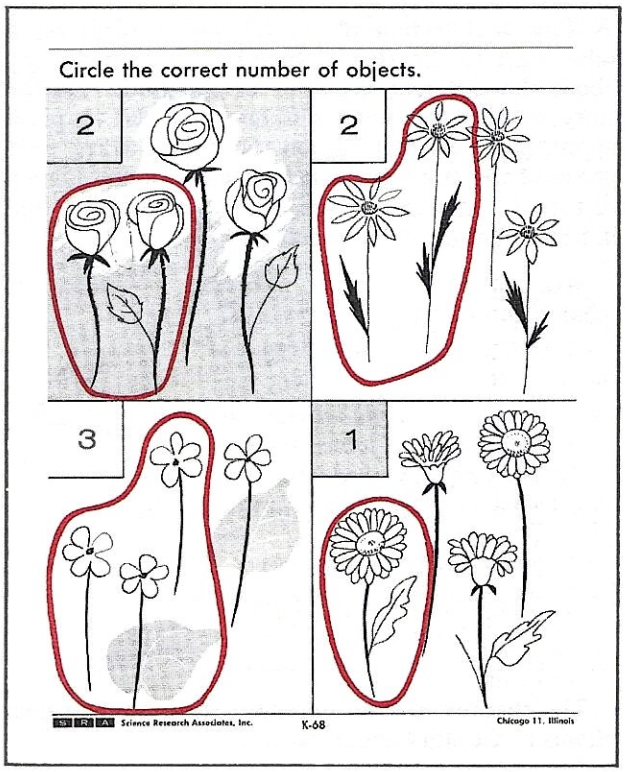
▶ On a large piece of construction paper, draw four sets of four circles each. Call upon one child to use two different-colored crayons, to work from left to right, and to show the number combination three plus one. Have other children show the combinations one plus three and two plus two. When the work is completed, discuss each set of four, in turn. Have the children tell which sets were joined to form the set of four.



▶ Use work page K-67 to help children visualize the sets used to form the given set of four. Direct the children to locate the set of tulips on the page. Ask one child to read the numeral in the box with the flowers. Explain to the children that they are to circle the number of tulips that the numeral represents. Proceed in this manner with the other sets on the page. When the children have completed their work on the page, have each set discussed. Call upon different children to tell which number combination is suggested by each picture.



★ More than one correct answer is possible for each problem.



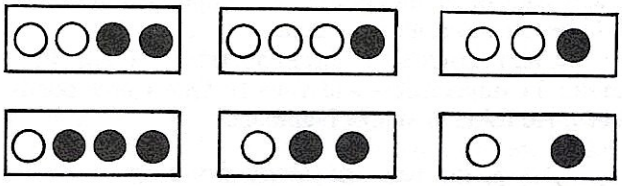
★ More than one correct answer is possible for each problem.

Use the same procedure to direct the work on work page K-68. Here children are provided with another opportunity to reinforce their understanding of number combinations relating to sets of four. Guide them to think informally about the commutative property of addition.

Supplemental Experiences

▶ "Act out" number combinations. Have four children stand in a straight line in front of the group. Tell the other children to close their eyes. Whisper to three of the four children to remain standing. Have the other child sit on the floor. Have the class open their eyes. Explain that they must "read" from left to right and tell what number combination the scene makes them think about. Choose four other children to represent another combination of four. Continue the game in this way as long as interest is evident.

▶ Construct number-combination picture-cards. Use circle stickers of two different colors. Hold the cards up, one at a time, before the group. Remind the children to examine the sets from left-to-right.



Have the children tell three things about the dot pictures: (1) the sets apparent within the given set; (2) the way in which the sets were joined; (3) the number combination represented.

Number Combinations of Four

Work Pages K-69 and K-70

Objectives

To help children work informally with the concept of subtraction.

To help children work informally with the concept of zero.

Fundamentals

Only in the environment of sets is the child being asked to solve the following type of problem: $3 + \square = 4$. Herein he searches for a missing addend. When he finds the missing addend in the problem, he really finds the difference $4 - 3$.

The kindergarten program only hints at the concept of subtraction in terms of the missing addend. The formal presentation of this concept of subtraction falls within the province of the first grade teacher. The main emphasis at this level will still be on addition combinations.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Addition of Whole Numbers; Subtraction of Whole Numbers.

Readiness for Understanding

The ability to join two sets to form a new set.

The ability to determine the cardinal number of the union of sets.

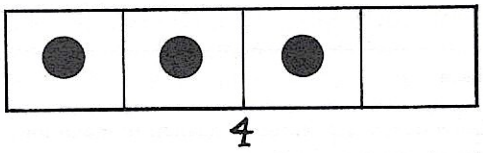
The ability to decide how many more objects must be joined to a given set to make a set of three.

Developmental Experiences

MATERIALS

- flannel board
- felt cutouts
- felt numerals 1 through 4
- tagboard latticework
- yarn
- clip clothespins
- four 4″ tagboard squares
- number-strips used in Developmental Experiences, work pages K-63 and K-64, and one four-block strip

▶ On the flannel board, place a strip of latticework with four openings. In the first three openings, place three felt disks. Put the numeral 4 under the latticework and have the children identify it. Ask them to tell how many more objects must be put with the set of three to make a set of four. Call upon one child to place the one disk of a different color in the fourth opening in the latticework. Have another child explain the situation in terms of joining of sets. He should say that a set of one was joined to a set of three to make a set of four. Have some other child tell what number combination he thinks about when



he looks at the sets on the board. He should say that three plus one is four. Remove the disks from the board. Repeat the procedure, but this time place two disks in the first two openings in the latticework. Have the children explain this arrangement in terms of sets as well as in terms of number combinations.

Now place four disks in the openings in the latticework. Ask the children to tell how many more objects are needed to make a total of four objects. Say that zero disks are needed to make a total of four.

Continue in the same way to develop the other combinations of four.

▶ Place all of the number-strips in scatter-fashion on one side of the flannel board. Put a three-strip in the center of the board. Ask the children to tell how many more blocks are needed with three to make four. Have one child place the one-strip next to the three-strip. Call upon another child to find a single-strip that has the same number of blocks as the pair of strips. Say that three plus one is four.

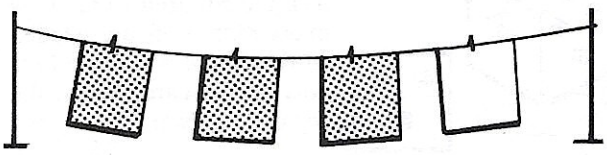
Now set the stage in such a way that the commutative property of addition will be obvious. Remove the four-strip from the flannel board. Place the one-strip under the three-strip on the board. Call upon a child to find the strip needed with the one-strip to make four. Have him place this strip next to the one-strip. Ask another child to tell two set-stories related to the illustration on the board. He should say that a set of one joined to a set of three makes a set of four; that a set of three joined to a set of one also makes a set of four.

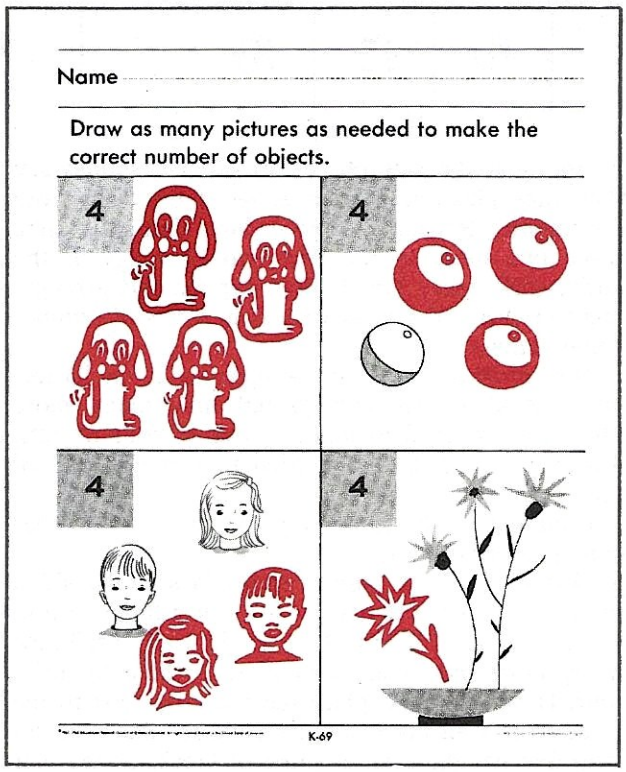
Some other child may tell about the number combinations he sees represented on the flannel board: three plus one is four, one plus three is four.

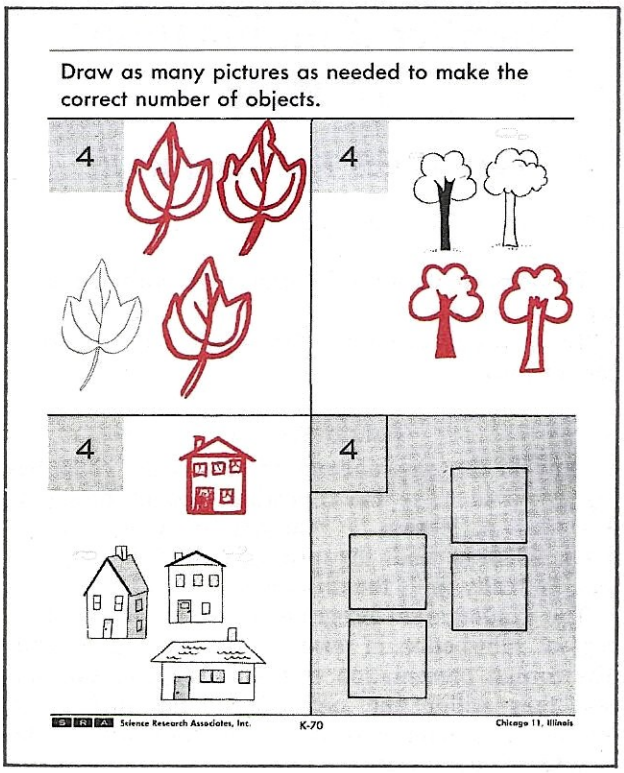
Place the four-strip under the others on the board. Ask the children to tell how many more are needed with this strip to make four. At this time say only that four plus zero is four.

Use the same procedure for the other number combinations of four.

▶ Stretch a piece of heavy yarn between two heavy pieces of classroom furniture. Fasten each end of the yarn securely to the furniture. Pin three tagboard squares on the line. Ask the children to tell how many more squares are needed to make four on the line. Have a child pin the one square of a different







color next to the three already on the line. Have the set-story told. Have the number combination specified. Continue in this way with the other combinations of four.

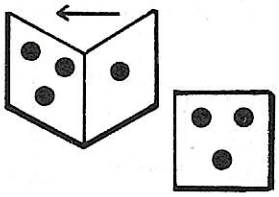
▶ Use work page K-69 to emphasize two ideas: the concept of zero and the "how-many-more" approach to addition combinations. Number combinations of four are developed.

Direct the attention of the children to the first box on the page. Tell the children to look at the numeral in this box. Have one child tell how many pictures he sees. Direct the children to think how many more pictures are needed to make the correct number. Say that they must now draw this many pictures. Continue in this same manner with the other sets on the page. When the work is completed, have the children discuss the number combinations related to the pictures.

Work page K-70 continues the development of combinations of four. Follow the same procedure suggested for work page K-69 when presenting the page.

Supplemental Experiences

▶ Draw three dots on one side of a domino card and one dot on the other side. Fold the card in half so that only the three dots are in view. Show the card, three-side out, to the group. Have someone tell how many dots he sees. Ask the children to tell how many more dots are needed so that there would be four dots on the card. When the correct answer has been given unfold the card so that the children can see both sides. Have the card "read" from left to right and the set story told. Ask someone to give the number combination of four which the card represents. Continue in this way; show other combinations of four on domino cards.



▶ Play the game "The Four Family." Have the children sit in a large circle. Place four chairs in the center of the circle. Choose one, two, or three children to come and sit in the chairs. Say that they are some of the children in the Four Family. The rest of the children are outside playing. Ask the class to tell how many of the Four children are outside. The chairs will help the less mature children discover the answer. Continue the game; compose other stories about the Four Family that involve different combinations of four. As the game progresses, remove the clue of the chairs.

Number Combinations of Five

Work Pages K-71 and K-72

Objectives

To extend the children's understanding of the union of sets.

To extend the understanding of the concept of addition to number combinations of five.

Fundamentals

At the kindergarten level, the entire development of the concept of addition aims at helping the child

gain an understanding of this basic operation on numbers. For the child, this understanding grows through varied and meaningful experiences with the fundamental ideas related to the concept.

The child develops an ability to work out additive number combinations in an environment of concrete elements. He is not required to use abstract symbolism. He is not required to work with abstract sets. He solves specific problems and gains insights into the problems as he manipulates object collections and sees pictures of sets.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Sets and One-To-One Correspondence; Addition of Whole Numbers.

Readiness for Understanding

The ability to join two sets to make a new set whose number is two, three, or four.

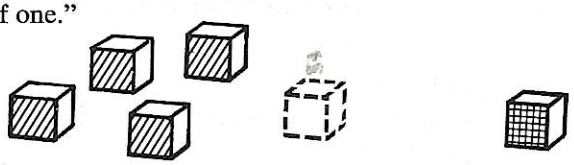
The ability to recognize a set of five objects.

Developmental Experiences

MATERIALS

blocks of two different colors
crayons of two different colors
heavy cardboard box cover
flannel board
felt numerals
felt cutouts

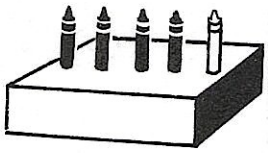
▶ Place a set of four red blocks and a set of one blue block, in that order, on a table in front of the children. Have one child join the set of one to the set of four. Ask him to explain what happens when he does this. He should say that he put a set of one with a set of four to make a set of five. Have another child tell what number combination he thinks of when he looks at the blocks. This child may tell the others that four plus one is five. Help the children visualize the original sets as subsets of the new set. Say, "A set of five contains a set of four and a set of one."



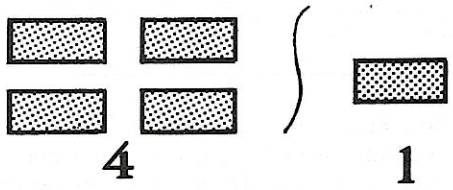
Repeat the activity. This time use sets of three and two, in that order. Have one child tell the class what happens when a set of two is joined to a set of three: a new set of five is formed. Call upon another child to use only the numbers of the sets to describe the combination he sees represented in this situation. He can say, "Three plus two is five."

Continue the development of the concepts of set union and addition. Now use sets of two and three, in that order, and sets of one and four, in that order. After the manipulation of the objects, have children describe the activity in terms of the joining of the sets. Have other children tell which two sets can be seen in the new sets. Still others may tell which number combinations are represented in the joining of the sets.

▶ Punch five holes, evenly spaced, in the top of a heavy cardboard box cover. Make the holes just large enough to support crayons. Have one child place four green crayons in the first four holes in the box cover. Ask a second child to place one orange crayon in the last hole. Call upon someone in the group to tell the class what happened in terms of joined sets. Have the number combination given. Proceed in this way with other combinations of five.

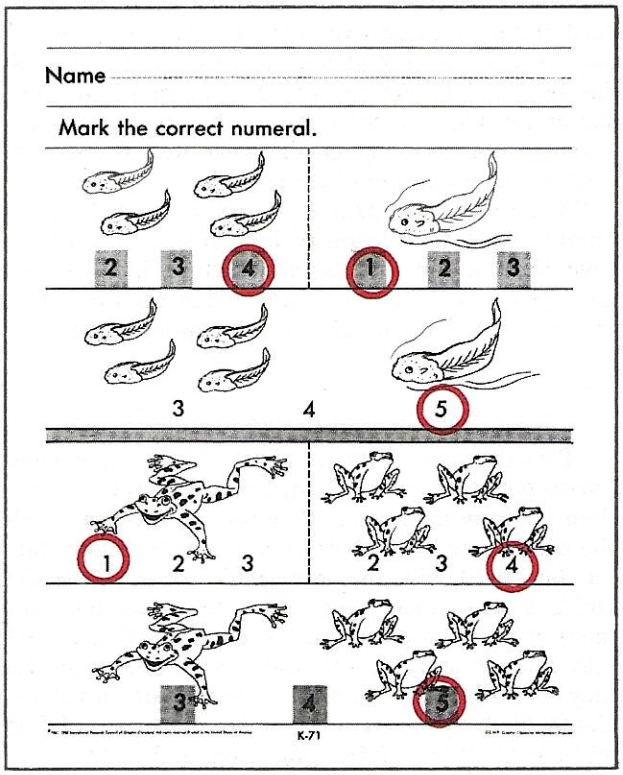


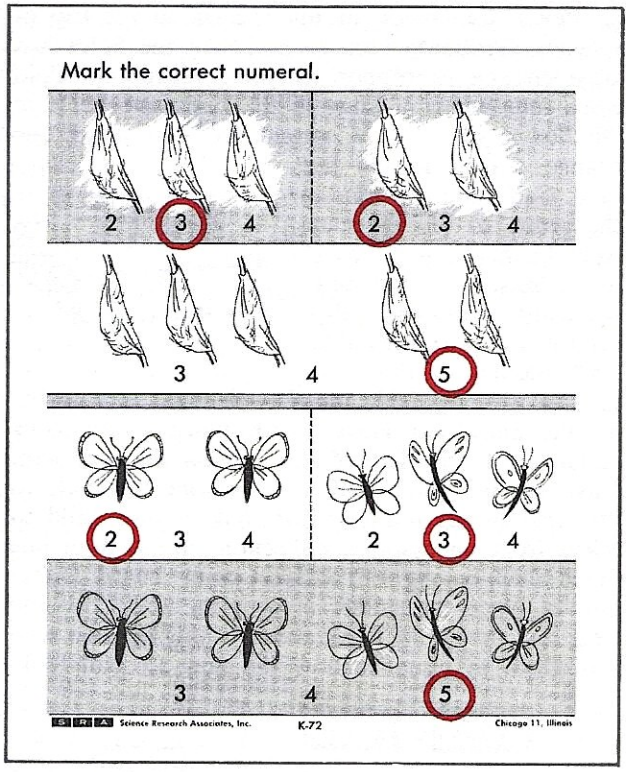
▶ Use yarn to divide the flannel-board area in the manner illustrated. Have a child place a set of four rectangles to the left of the vertical line segment. Have another child place a set of one rectangle to the right of the line segment. Ask a third child to select from an assorted collection of felt numerals those which belong with each set on the board. Direct him to place the numerals with the sets. Tell the class that they must think about joining the two sets. Ask them to visualize how the new set will look.



Call on a child to remove the piece of yarn, to put the set of one with the set of four. Have another remove the numerals 4 and 1 which appeared under each set and replace it with the numeral 5. Continue in this way to join two other sets to make a set of five.

▶ Use work page K-71 to reinforce the understand-





ing of the concept of union of sets. Tell the children to fold the worksheet so that only the upper section of the page is in view. Direct them to examine the two sets of tadpoles near the top of the paper. Have someone read the numerals under each set. Tell the children that they must mark the one correct numeral in the first box that stands for the number of tadpoles in the set. Next they must mark the correct numeral in the second box that stands for the number of tadpoles in that set. Explain that they must think of these two sets as a single set when they look at the second row. Discuss the number of this new set. Direct the children to mark the one numeral which represents the number of the new set.

In the same way, guide the work with the sets of frogs on the lower half of the page.

When using work page K-72, follow a similar procedure. Upon completion of both sides of the sheet, have the children discuss the picture in terms of joining of sets, in terms of sets within each new set, and in terms of the number combinations developed.

Supplemental Experiences

▶ Play the game "Stars at Night." Place three white felt-cutout stars on the flannel board. Have the children tell how many stars they see "in the sky." Tell the children to close their eyes. Put two yellow stars on the board with the three white stars. Have the children open their eyes. Have the class tell how many more stars came out "in the sky." Some child may tell the story of the joined sets. Someone else may describe the number combination involved. Continue the game. Use other combinations of five and combinations of four, of three, and of two.

Number Combinations of Five

Work Pages K-73 and K-74

Objectives

To help children recognize the number combinations of five.

To continue to develop, in an informal way, the concept of commutativity of addition.

To re-emphasize the known concept of pairs of sets within a given set.

Fundamentals

The child, at the kindergarten level, is learning that one way to describe a set is to identify its elements. He is also learning that it is possible to single out certain elements among those which belong to a set.

As his work with additive combinations of five advances, the child is discovering that it is possible to find a set of two and a set of three, as well as other pairs of sets, within a set of five. He is becoming aware that each element in the set of two and each element in the set of three is also an element of the given set of five.

The mathematician designates these sets within sets as subsets of a given set. A subset that is different from the set itself and different from the empty set is called a *proper* subset. The child is learning to think of subsets as parts of a given set.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Sets and One-To-One Correspondence; Addition of Whole Numbers.

Readiness for Understanding

The ability to join two sets to form a new set.

The ability to determine the cardinal number of the union of sets.

The ability to visualize sets within a given set.

Developmental Experiences

MATERIALS

strip of heavy cardboard (3″ x 6″)
5 clip-type clothespins
flannel board
felt numerals
felt cutouts
yarn
colored chalk

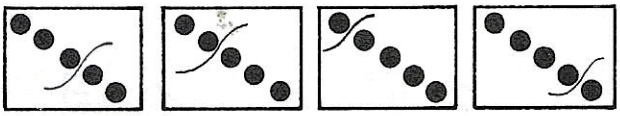
▶ On the chalkboard, draw five rectangles. Divide each shape into five parts, of the same length. Ask the children to tell how many blocks they see in each rectangle. Call upon one child to show to the class the ordered pair of sets he visualizes within one of the given sets of five blocks. Have him use two different-colored pieces of chalk to show these two subsets. Ask other children to show different pairs of sets within a set of five. Some child may say that he sees a set of five and a set of zero in one of the sets of five. This will be an exceptional child, but

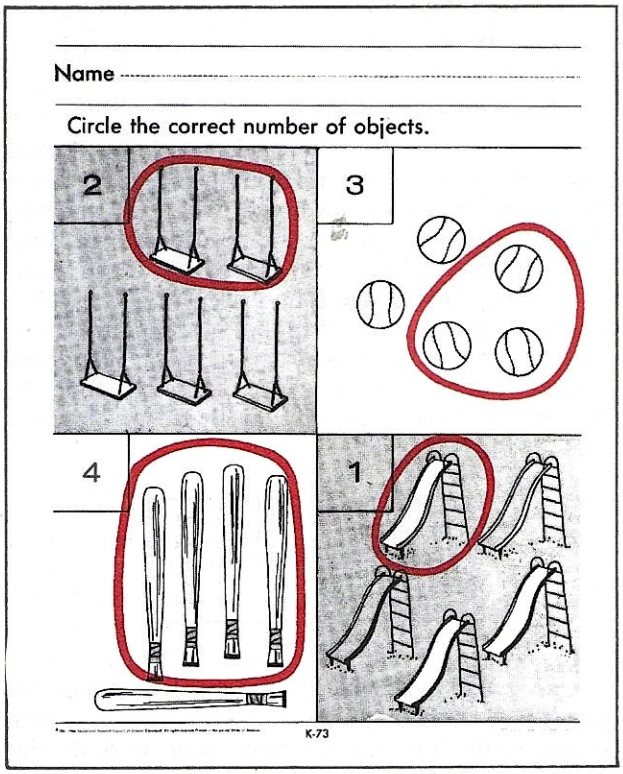
encourage this kind of thinking at all times. If no one sees this combination, the teacher can fill in five blocks herself and merely say, "I see a set of five and a set of zero in this set of five."

Have each pair of subsets within the sets of five discussed. Tell children to read from left to right and give the related number combinations for each pair of subsets. Emphasize the commutative property of addition.

▶ Place five clothespins along the top of a strip of heavy cardboard. Have the children tell how many are in the set they see. Ask someone to show which pair of sets he sees in the set of five by placing one of the sets along the bottom of the card. Have the children read from top to bottom and give the related number combination. Give other children the opportunity to show different pairs of subsets and to tell the related additive combination.

▶ Arrange four sets of five on the flannel board in the pattern illustrated. Have the children give the cardinal number of each set. Ask them to show pairs of sets within the sets of five by placing a strip of yarn between the two sets they see contained within the given set. Tell the children to read from left to right and tell how the sets were joined to make each set of five. For example, with the first pair of sets a child would say, "A set of two was joined to a set of three to make a set of five." Another child giving the related number combination would say, "Three plus two is five." As the activity progresses, stress the commutative property.





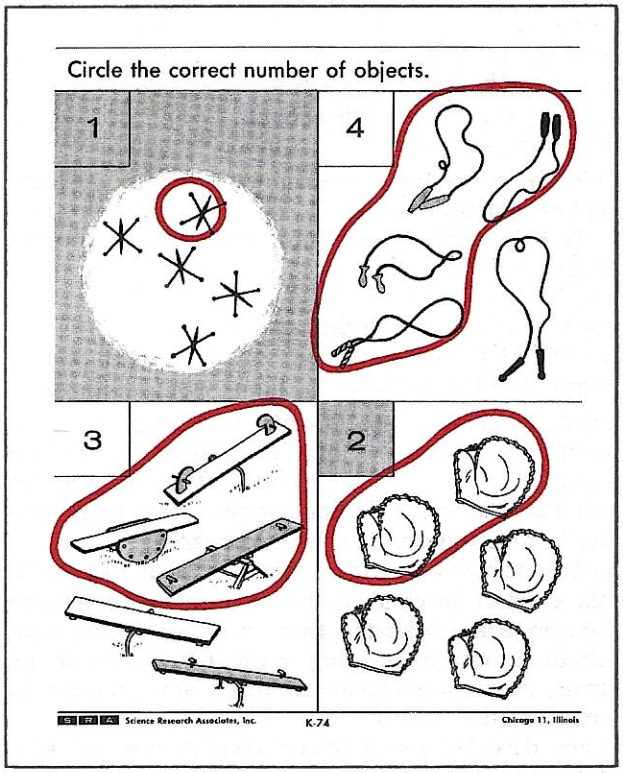
★ More than one correct answer is possible for each problem.

▶ Work page K-73 will provide another opportunity to help children visualize subsets within a given set. Tell the group to find the set of swings on the page. Ask one child to read the numeral in the box with the swings. Explain to the children that they are expected to circle the number of swings that the numeral represents. Continue in this way with the other sets on the page. When the work on the page is completed, have each set discussed in terms of the subsets and number combinations involved.

The same procedure can be used to direct the work on work page K-74. The children are provided with another opportunity to reinforce their understanding of the number combinations relating to sets of five. They can be guided to think informally about the commutative property of addition.

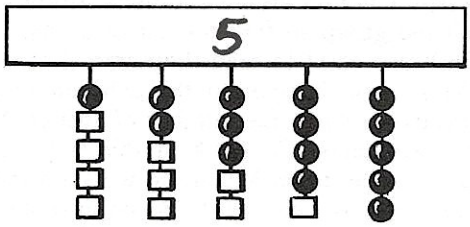
Supplemental Experiences

▶ Use felt disks that have a different color on each side. Place five of these disks on the flannel board with only one color evident at first. Call upon a child to begin at the left and turn over any number of disks that he chooses, to show a subset within the given set. Have the number of this subset named. Ask what other set within the given set is also evident. Have the number of this second subset named. Ask the children to give the additive combination related to these subsets. Tell them that they must read the set-picture from left to right and give the combination in that order.



★ More than one correct answer is possible for each problem.

▶ Construct a bead display to show the additive combinations of five in permanently visible form. Use two kinds of beads (red and blue, round and cubed).



▶ Play a bowling game to illustrate pairs of sets within sets of five. Line up five pins in a row. Have the children take turns rolling a ball to knock down the pins. Discuss the number combinations represented by the pins standing and those knocked down. If two pins are down and three pins are standing, some child would say that three plus two is five.

Number Combinations of Five

Work Pages K-75 and K-76

Objectives

To help children work informally with the concept of subtraction.

To help children work informally with the concept of zero.

Fundamentals

The child is learning to think about how many more objects he needs in order to have a particular number of objects. He may have three pennies. He wishes that he had five pennies. The problem for him becomes one of finding out how many more pennies he needs to make his wish come true.

Although the concept of subtraction is implied in this setting, the child at this time is encouraged to think in terms of finding that set of pennies he must join to the one he now has in order to get the set he wants. He continues to approach his problem in terms of union of sets.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Addition of Whole Numbers; Subtraction of Whole Numbers.

Readiness for Understanding

The ability to join two sets to form a new set.

The ability to determine the cardinal number of the union of sets.

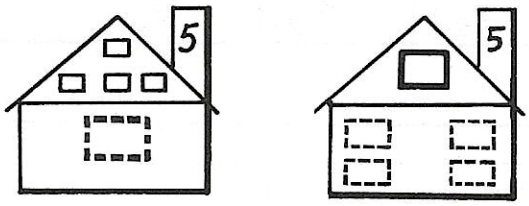
The ability to decide how many more objects must be joined to a given set to make a set of four.

Developmental Experiences

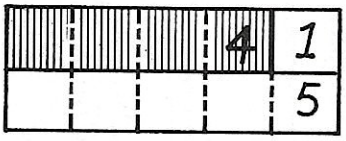
MATERIALS

set-cards one through five
flannel board
felt numerals 1 through 5
felt cutouts
number-strips one through five

▶ Draw five pictures of houses on the chalkboard. On one floor of each house put one, two, three, four, or five windows. Write the numeral 5 in each chimney. Have the number of the set of windows in the first house named. Ask the children to think how many more windows the house needs so that it has the number the numeral represents. Call upon one child to draw the needed number of windows in the lower section of the house. Have the class read from top to bottom and discuss the joining of the two sets. Have someone give the related number combination: four plus one is five. Continue in this way to develop all possible combinations of five, including five plus zero.



▶ In scatter fashion on one side of the flannel board, place all of the number-strips. Put a four-strip in the center of the board. Have the children tell how many more blocks are needed with the four blocks to make five blocks. Have one child place the one-strip next to the four-strip. Call upon someone else to find a single strip that has the same number of blocks as the pair of strips. Direct this child to place the strip he has chosen directly under the four-strip and the one-strip. Say that four plus one is five.



Now make the clues point to the commutative property of addition. Remove the five-strip from the flannel board. Place the one-strip under the four-strip on the board. Call upon a child to find the strip which must be combined with the one-strip in order

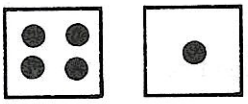
to make a set of five. Have him place this strip next to the one-strip. Ask another child to tell two set-stories related to the illustration on the board. He should say that a set of one joined to a set of four makes a set of five; that a set of four joined to a set of one also makes a set of five.

Some other child may tell about the number combinations he sees represented on the flannel board: four plus one is five, one plus four is five.

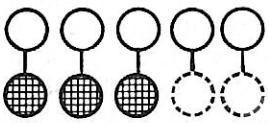
Place the five-strip under the others on the board. Ask the children to tell how many more are needed with this strip to make five. After they say that no more are needed, remark, "Zero objects are needed. Five plus zero is five."

Use the same procedure for the other number combinations of five.

▶ Distribute set-cards one through five. Have a duplicate set on hand to use on the flannel board. Place the four-card on the board. Above this set-card place the numeral 5. Tell the children that the one who has the set that can be joined to the given set to make a set of five must come and place it on the flannel board. Have the set story told. Have someone give the related number combination. Proceed in this way to have the children join the other pairs of sets which make a set of five.



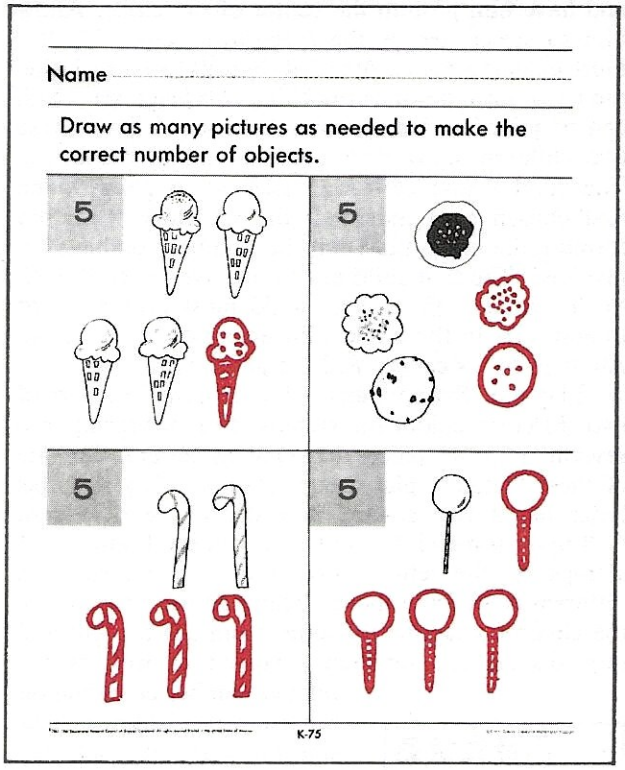
▶ Compare sets. Place a set of five felt cutouts on the flannel board. Directly under the first three cutouts of this set, place a set of three cutouts. Have the children decide how many more are needed with the set of three to make a set of five. Ask someone to place the required set directly under the last two cutouts in the set of five. Help the children see that the new set on the bottom can now be matched one-to-one with the original set. Discuss the fact that a set of two had to be joined to a set of three in order to have this one-to-one correspondence. Compare other proper subsets of the cutouts on the bottom five with the original set of five in order to discover how many more are needed to put the two sets in one-to-one correspondence.



▶ Use work page K-75 to reinforce two ideas: the concept of zero and the "how-many-more" approach to addition combinations. Number combinations of five are developed.

Direct the children's attention to the set of ice-cream cones. Have them look at the numeral that appears with this set. Ask one child to tell how many cones he sees. Guide the children to think how many more pictures are needed to make the correct number, the number represented by the numeral in the box. Say that they must draw this many cones. Proceed in this way with the other sets on the page. When the work is completed, have the children discuss the number combinations related to the pictures.

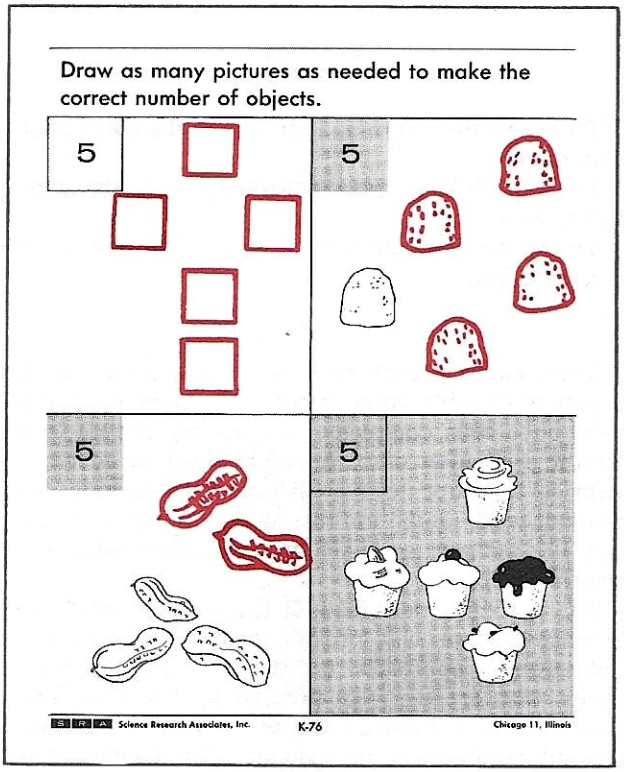
Work page K-76 continues the development of



combinations of five. Follow the same procedure suggested for work page K-75 when presenting this page.

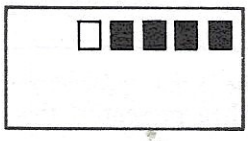
Supplemental Experiences

▶ Have the group sit in circle formation. Give five of the children set-cards one through five. Place a duplicate collection of set-cards face down in the middle of the circle. Choose a sixth child to be "it"



and have him go into the center of the circle. Allow him to select one of the face-down set-cards. "It" must examine his card and then walk around inside the circle until he finds the child who has a set which can be joined to his set to make a set of five. These two children show their cards to all in the circle. The child whose card was selected to go with the first chosen card must tell the set story. Children forming the circle must tell the number combination involved. The first child must now give his card back to the teacher; the second child must give his card to someone in the circle who does not have a card. Another "it" is chosen and the game continues.

▶ Play the "Stamp Game." Use gummed stickers of two different colors for stamps. Cut newsprint into several 5″ x 8″ pieces to serve as letters. On one of these "letters" place four "stamps." Say that this letter needs five stamps in order to be delivered. Call upon some child to place the needed number of stamps on the letter. Have him use stamps of a different color from those already on the letter. Have the children examine the letter from left to right and then discuss the set-story involved as well as the related number combination represented. Continue "getting other letters ready for delivery." Use combinations of two, of three, of four, and of five.



Number Combinations of Two Through Five

Work Pages K-77 and K-78

Objectives

To review the informal approach to the concept of subtraction.

To help children work informally with the concept of zero.

To lay the foundation for a more direct approach to subtraction.

Fundamentals

Some children may be ready for a more direct treatment of subtraction. After work pages K-77 and K-78 have been completed, the teacher can make a careful evaluation of each child's level of development in this area. It may be wiser to provide additional work with additive combination and use only the indirect approach to subtraction with less mature groups.

The activities described in the supplemental experience section will provide experience with the "take-away" approach to subtraction for those groups who are ready to proceed in this area. The inverse relation between the operations of addition and subtraction will be evident. The kindergarten teacher will not stress this relation. It is introduced formally and developed in detail in grade one. She will only expose the child informally to the concept.

In this more direct approach to subtraction, care must be exercised to use precise language. When dealing with sets use the terms *take away* or *remove*. *Subtract* and *minus* must be reserved for work with numbers.

See KEY TOPICS IN MATHEMATICS FOR THE PRIMARY TEACHER: Addition of Whole Numbers; Subtraction of Whole Numbers.

Readiness for Understanding

The ability to join two sets to form a new set.

The ability to determine the cardinal number of the union of sets.

The ability to decide how many more objects must be joined to a given set to make a set of five.

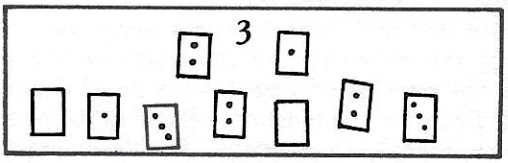
Developmental Experiences

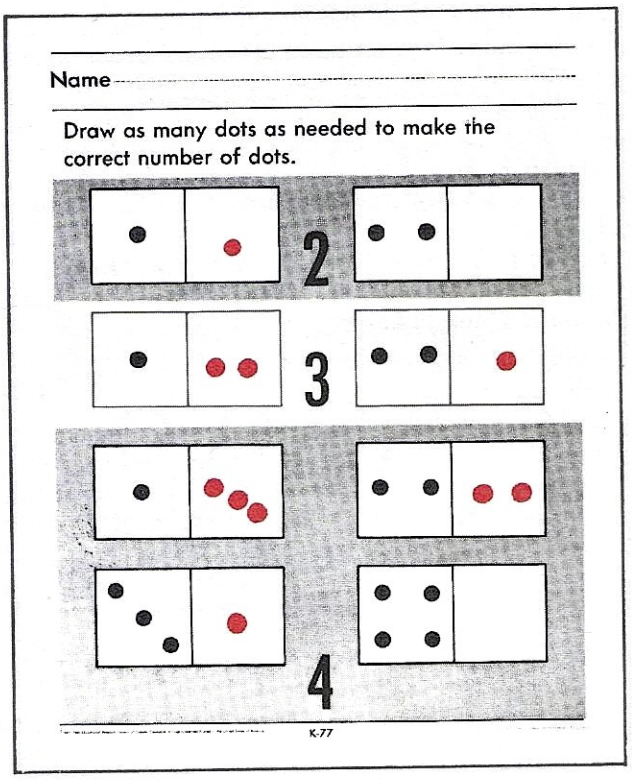
MATERIALS

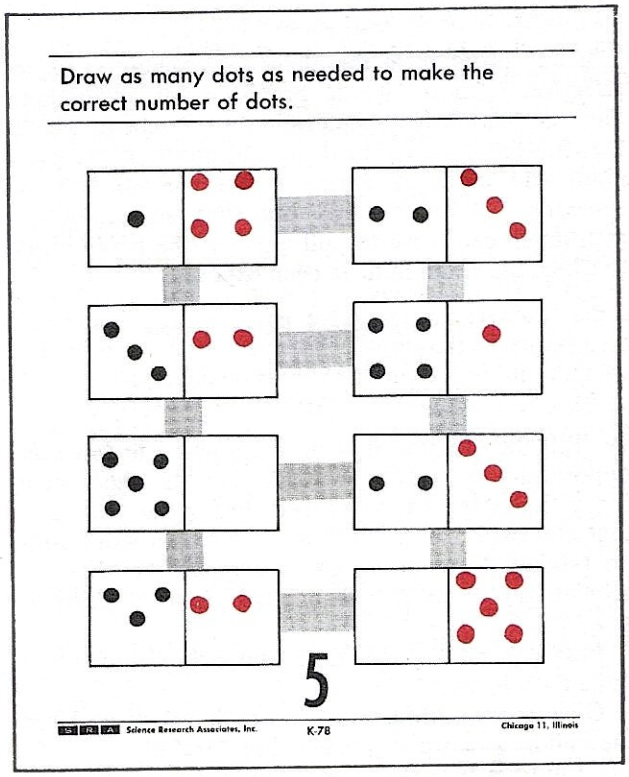
large piece of construction paper
crayons
flannel board
felt numerals 1 through 5
several set-cards zero through five
colored chalk

▶ Draw the outline of a domino on a large piece of construction paper. In half of the domino, use a crayon and draw four dots. Write the numeral 5 under the domino and have the children identify it. Ask them to tell how many more dots must be drawn on the domino so that there will be five altogether. Call upon one child to draw the one dot in the empty half of the domino. Have another child explain in terms of sets the situation illustrated on the page. Another child may give the related number combination. Continue in this way to review combinations of five, of four, of three, and of two. Include zero in the combinations.

▶ Place set-cards one through three in scatter fashion along the bottom edge of the flannel board. Use two sets of one, three sets of two, two sets of three, and two cards with no pictures. When the activity is completed, it will be found that there is an extra card left over. Place the numeral 3 at the top of the board. Call upon several different children to choose a pair of sets which when joined will form a set which has the number the numeral represents. Have them place the sets under the numeral. When all possible additive combinations of three have been formed, discuss each in terms of joined sets and number combinations. Review combinations of two, of four, and of five in this same manner. Always include extra cards in the multiple-choice set.







▶ Draw a large birthday cake on the chalkboard. Draw three candles on the cake. Tell the children that this cake is for a little girl who is five years old. Ask if the cake has enough candles. Have one child draw as many more candles as are needed to make a set of five. Use two different colors of chalk to make the candles. Have some child tell the set-story; have another child give the related number combination. Proceed in this way to review number combinations of two, of three, of four, and of five.

▶ Use work page K-77 to review number combinations through four. Work with the children a row at a time. Have them examine each domino in turn, determine the number of the given set of dots, and draw in the other half of the domino as many more as are needed to make a set of dots whose number is represented by the numeral. Discuss the sets and number combinations when the page is completed.

Work page K-78 provides a review of number combinations of five. Proceed in the manner suggested for work on work page K-77.

Supplemental Experiences

▶ Place one bead on a wire or piece of heavy string. Have some child join another bead to the first set of one. Ask for a volunteer to tell the set story. Call upon someone to tell the class how many beads are now on the wire. Remove one of the beads. Say, "When I remove or take away a set of one from a set of two, I have a set of one. Two minus one is one." Continue on succeeding days with other sets.

▶ Use fold-back domino-cards. Hold up a two-card with only a set of one exposed. Have the children tell how many more objects are needed to make a set of two. With the card opened fully, have the set story told. Now begin with the set of two. Tell the children you will remove one of the objects. Fold one side of the card back out of sight. Ask how many objects are visible. Say, "I start with a set of two and take away a set of one. Two minus one is one." Later, develop all other sets through five.

▶ Put a set of two felt cutout airplanes on the flannel board. Have the number of the set identified. Tell the children to close their eyes. Remove one of the airplanes. Direct the children to open their eyes and tell how many airplanes flew away. Have them tell how many airplanes they still see. Perhaps some will be able to tell the set story and give the related number sentence. This procedure can be used with other sets through five.

Evaluation

Work Pages K-79 and K-80

Objectives

To evaluate the children's awareness of shapes and visual patterns.

To evaluate the children's understanding of the numbers and numerals 1 through 10.

To evaluate the children's understanding of the concepts of set and subset.

Fundamentals

If any program in the elementary school is to be effective, it must include provision for evaluation. Such evaluation helps determine the extent to which the children have attained the objectives of the program and indicates areas in which more help is necessary. Often it turns out that an evaluative instrument can serve to pull together the many ideas to which the children have been exposed.

Developmental Experiences

MATERIALS

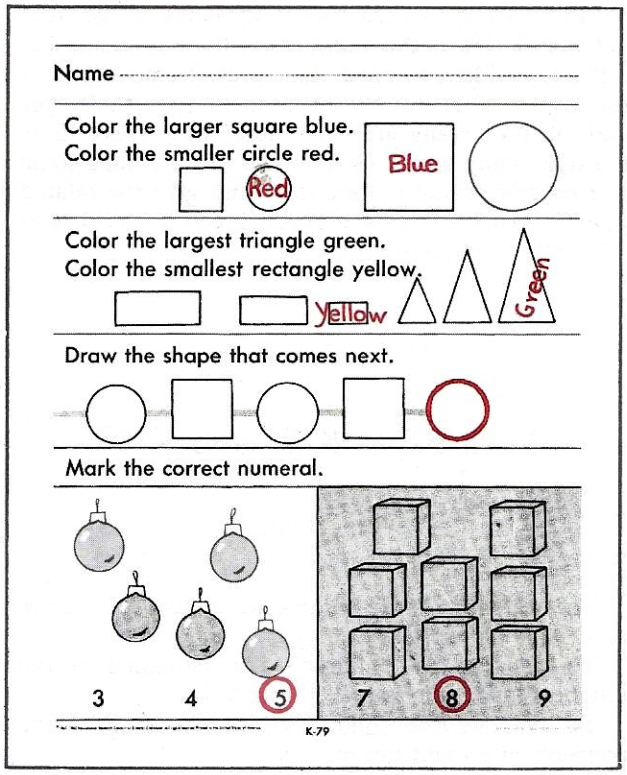
crayons

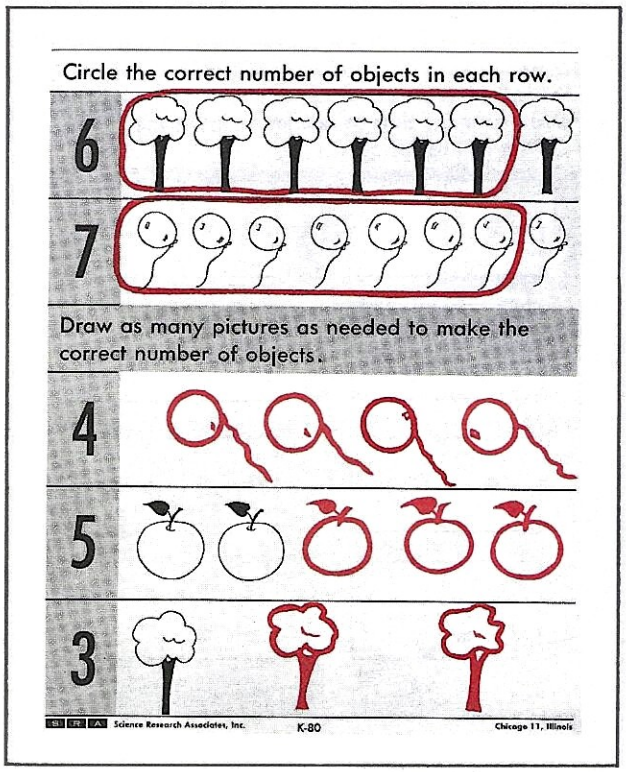
▶ Tell the children that they are going to have an opportunity on this new work page to show how many things they have learned during the year. Say that you expect each child to do his own work with no talking. You may wish to arrange the chairs a special way or work with a small group of children at a time.

Pass out work page K-79 and help the children write their names.

Give specific directions for each exercise. Urge the children to work quickly, but carefully.

1. Find the first row. Color the larger square blue. Color the smaller circle red.
2. Find the second row. Color the largest triangle green. Color the smallest rectangle yellow.
3. Look at the third row. Think about the pattern. Draw the shape that comes next.
4. Now look at the first box at the bottom of the page. Find the number of the set of balls. Mark the correct numeral.





★ More than one correct answer is possible for each problem.

5. Look at the last box on the page. Mark the numeral which stands for the number of the set of blocks.

Have the children turn their papers over to work page K-80. Again give specific directions for each exercise.

1. Find the first row. Look at the numeral. Think about the number it names. Mark the correct number of trees.
2. The numeral in the second row tells you how many balloons to mark.
3. Look at the numeral in the third row. Draw the correct number of balloons.
4. The numeral tells how many apples should be in the box. Draw as many more as you need to have the correct number of apples.
5. Draw as many trees as you need to have a set with the correct number.

Go over each child's paper with him individually. If any child has had difficulty, ask questions to determine the cause of the difficulty. Give more help and assurance wherever it is needed.

Supplemental Experiences

▶ Have the children recall the many things they have learned about numbers, sets, and shapes. They may enjoy planning a program for their parents or for the other children in the school. Such a program may include games and songs which the children especially like and which have helped in building number concepts. Special displays of shapes, charts, manipulative aids, and work pages can be set up.

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